A DICTIONARY OF CHEMICAL SOLUBILITIES

INORGANIC

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A DICTIONARY OF CHEMICAL SOLUBILITIES

INORGANIC

FIRST EDITION

BY

ARTHUR MESSINGER COMEY, PH.D.

SECOND EDITION

ENLARGED AND REVISED

BY

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With the facilities offered by the various scientific libraries at Harvard University, the Massachusetts Institute of Technology, and other libraries in Boston, it has been possible to collect nearly all the data relating to the subject. For the work before 1860 Professor Storer's work has been found invaluable.

The method pursued has been to form a preliminary list of compounds with more or less data by consulting the two most complete works on inorganic chemistry—Gmelin-Kraut's "Handbuch der anorganischen Chemie" and Graham-Otto-Michaelis's "Lehrbuch." These statements have been verified and elaborated by consulting the original memoirs in all the periodicals devoted to chemical literature which were obtainable. The "Jahresbericht der Chemie" also has been used extensively in tracing references, but the original memoirs have always been consulted and references given to them when possible.

It has been found impracticable to draw any distinction as to reliability between the various data given by different observers. It was manifestly impossible to attempt to verify experimentally the statements of those who have carried on the researches, for the most assiduous labor of many could only cover a small portion of the attested facts. Therefore, even when two statements are directly contradictory, both have been given with the authority for each. The only exception to this has been made when more recent discoveries have shown beyond any reasonable doubt the falsity of previous work. In this way some of the older manifestly inaccurate work has been omitted. In a majority of cases the more recent work may be considered to be the more accurate, but this is not the invariable rule. A Synchronistic Table of the more common periodicals is given in the Appendix, whereby it is easy to determine the date of the publication of a research to which reference is made.

It may be objected by the practical chemist that most of the work previous to 1850 might well have been omitted, but a great deal of this work possesses at least a historical value, and often furnishes facts which have not since been verified. Much of the earlier work, when obviously of less importance, has been printed in smaller type.

The aim has been to include in this volume all analyzed inorganic substances, that is, all substances which do not contain carbon, but exception has been made in the case of CO_2, CO, CS_2, the carbonates, cyanides, ferro-cyanides, etc., which are here included.

The work has been brought up to March, 1894, when this volume went to press, and the results of researches published since that time are not included in the present edition.

It is hoped that this book will fill to some extent the want that has been felt by chemists for a compilation of this nature. While it has been attempted to make the book as free from errors as possible, nevertheless it is naturally impossible to avoid many mistakes, and the compiler will be very grateful to those who may call his attention to any errors or omissions.

A. M. C.

CAMBRIDGE, MASS., Aug., 1895.

PREFACE TO SECOND EDITION

During the twenty-five years which have elapsed since the publication of the first edition of this dictionary, a very large amount of work has been published in chemical periodicals, containing data concerning the solubility of inorganic chemical compounds. As it was impossible for the compiler of the first edition to devote the time necessary for the collecting of the published data, it was necessary to employ assistance, and Dr. Dorothy A. Hahn, Professor of Chemistry, Mt. Holyoke College, was engaged for this work. Dr. Hahn has collected the larger part of the material in this book, which work in spite of its arduous and tedious nature, she has performed in a most painstaking manner.

The compilation and arrangement of the data collected by Dr. Hahn, which devolved upon the original author, took much time. This, together with difficulties in printing, caused by the general conditions after the war, has delayed the publication until the present year, although the work was begun in 1916, and it has only been brought up to January 1st of that year.

Since the publication of the first edition of this work, Dr. Atherton Seidell has brought out two editions of his book, entitled "Solubilities of Inorganic and Organic Substances," which covers quite a different field, as he considers only quantitative data and those only for the commoner substances. Dr. Seidell has followed the plan in most cases where there are several available solubility determinations of a substance, of selecting and averaging the more reliable results, and embodying them in tables. Although this undoubtedly facilitates ready reference, it has seemed better to adhere to the original plan of the first edition, and to publish all the data in the form of the original authorities with references and dates, so that the user may be at liberty to use his own judgment in selection. Some few of the tables arranged by Dr. Seidell, however, have seemed to possess decided advantages over any other published data and they have been incorporated in the present volume. It is desired also to acknowledge indebtedness to Dr. Seidell's work for certain other tables where the original sources were not available to the present compilers.

The same plan and arrangement used in the first edition has been followed with certain elaboration, however, of the arrangement of data on the solubility of two or more salts in a solvent, which is explained in the Explanatory Preface

Data published since the first edition on the cobalt and chromium ammoni compounds and those of the platinum group have been omitted, as it seeme that solubility data on those compounds possessed very little general interest

As stated in the preface of the first edition, while every possible atter been made to avoid errors, it is manifestly impossible to avoid many mis a work of this nature, and the compiler will be glad to have his attentio to any errors or omissions.

Wilmington, Del., Jan., 1921.

EXPLANATORY PREFACE

In order to reduce this volume to a convenient size the subject-matter has been abbreviated and condensed as far as seemed compatible with clearness; but it has been the aim not to use any abbreviations which are not at once intelligible without consulting the explanatory table. The more common chemical formulæ have been universally used, thereby saving a large amount of space without detracting from ready intelligibility to chemists.

The solubility of the substance in water is first given, the data being arranged chronologically in the longer articles. Then follow the specific gravities of the aqueous solutions, and also any data obtainable regarding their boiling-points; other physical data concerning solutions are not included. Following this is the solubility of the substance in other solvents—first the inorganic acids, then alkali and salt solutions, and finally organic substances.

Owing to the great increase of data, published during the last twenty years, on the simultaneous solubility of two or more salts in a given solvent, it has been found necessary to plan some arrangement, whereby such data can easily be found, and the plan adopted is as follows: The data for the solubility of two salts in a solvent is placed under the salt which comes first according to the alphabetical arrangement in this dictionary, and the order of the data on various salts under the same heading follows the alphabetical order of the salts considered. Thus the data on the solubility of $NH_4Cl+BaCl_2$, $NH_4Cl+CuCl_2$, and $NH_4Cl+PbCl_2$, and $NH_4Cl+(NH_4)_2SO_4$ are placed under Ammonium Chloride and arranged in the given order. Certain exceptions have been made to this rule, where the data directly concerns the solubility of a salt in a solution of another salt, in which case, it is placed under the former. Numerous cross references, however, are given, which it is hoped will avoid confusion.

In many cases no definite distinction can be drawn between the phenomena of solution and decomposition. At present the theory of solution is in a confused state, and until what really takes place when a substance dissolves is thoroughly understood no distinct line can be drawn. The whole subject is unsettled at the present time; for while many chemists believe in the so-called "dissociation" theory, yet the "hydrate" theory is not without its supporters. It is not my intention to discuss the theoretical side of the question, which has been so well treated in many recent works. It is, however, obvious that the phenomena are essentially different, when, for example, sodium carbonate is dissolved in water, in which case the original salt is deposited on evaporation, and when iron is dissolved in sulphuric acid, and the solution deposits a sulphate of iron. Yet it is still the custom to speak of iron as soluble in sulphuric acid, although it would be much more accurate to say that the sulphuric acid was decomposed by the iron. It has thus been found impracticable to draw a sharp line between solu-

tion and decomposition, and the term "soluble" has in general been used where a solution of some sort is formed by the action of the solvent.

The matter of alphabetical arrangement of chemical compounds, in the present somewhat confused state of chemical nomenclature, has been a difficult question to decide. The plan followed has been practically that of the standard Dictionaries of Chemistry, whereby the compounds of metals with one of the non-metallic elements have been classified under the metals, while the salts of the other acids (the oxygen acids so called and some few others) have been arranged alphabetically under the acids. Thus barium chloride is found under barium, while barium chlorate is found under chloric acid. No exception has been made in the case of the rare metals, as is usually the custom in Dictionaries of Chemistry. Double salts are to be found under the word which comes first alphabetically; thus, "common alum," potassium aluminum sulphate, is found under aluminum sulphate as aluminum potassium sulphate (under sulphuric acid), but ammonia chrome alum is found under ammonium sulphate as ammonium chromium sulphate. In the same way the double sulphate and chromate of potassium is found under potassium chromate (chromic acid), and not under potassium sulphate (sulphuric acid). The double chloride of ammonium and magnesium is found under ammonium chloride (ammonium), while the double chloride of potassium and magnesium is found under magnesium chloride (magnesium). An exception is made, however, in the case of double compounds of salts of oxygen acids with salts containing a single non-metallic element, in which case they are always found under the oxygen acid. Thus the double sulphate and chloride of lead, $PbSO_4$, $PbCl_2$, is found under lead sulphate (sulphuric acid), and not under lead chloride (lead).

The above method in some cases widely separates analogous compounds, but it was found to be the only practical way to a strictly alphabetical arrangement, which is so necessary in a book containing so many very short articles.

The ammonia addition-products furnished another difficulty. While their nature is more or less definitely understood in the cobalt, platinum, etc., compounds, and a definite nomenclature is in general use, there is an absolute lack of anything of the kind in the less definite compounds. It is good usage to speak of cuprammonium compounds, but how shall we designate the analogous cadmium compounds? "Cadmammonium" has not yet received the sanction of chemists, and $AlCl_3$, NH_3 is a still worse case for naming. I have, therefore, not attempted to name these compounds, but classified them all under the salts to which the ammonia is added, affixing the word ammonia, thus: aluminum chloride ammonia, cadmium chloride ammonia, and also cupric chloride ammonia for the salt now almost universally known as cuprammonium chloride.

The ammonia compounds of cobalt, chromium, mercury, and the platinum metals are arranged alphabetically according to their universally accepted names, a list of which is given under each of those elements.

It has further been necessary to settle arbitrarily the question whether a substance should be considered as a double salt or a salt of a compound acid con-

ABBREVIATIONS

abs.—absolute.
atmos.—atmosphere.
b.-pt.—boiling-point.
comp.—compound.
conc.—concentrated.
corr.—corrected.
cryst.—crystallised, crystalline
decomp.—decompose, decomposes, decomposition, etc.
dil.—dilute.
eutec.—eutectic.
insol.—insoluble.
M.—a univalent Metal.
Min.—Mineral.
mol.—molecule.
m.-pt.—melting-point.
ord.—ordinary.
n.—normal.
ppt., pptd., etc.—precipitate, precipitated, etc.
pt.—part.
sat.—saturated.
sl.—slightly.
sol.—soluble.
sp. gr.—specific gravity.
supersat.—supersaturated.
t° = temperature in Centigrade degrees.
temp.—temperature.
tr. pt.—transition point.
vol.—volume.

ABBREVIATIONS OF REFERENCES

A.—Annalen der Pharmacie, edited by Liebig and others, 1832–39; continued as Annale Chemie und Pharmacie, 1840–73; continued as Justus Liebig's Annalen der Che 1874–1915+. 406 vols.
A. ch.—Annales de Chimie et de Physique. Paris. 1st series, 1789–1816, 96 vols.; series, 1817–40, 78 vols.; 3rd series, 1841–63, 69 vols.; 4th series, 1864–73, 30 v 5th series, 1874–83, 30 vols.; 6th series, 1884–93, 30 vols.; 7th series, 1893–1903, 30 v 8th series, 1904–13, 30 vols.; 9th series, 1914+, 3 vols.
Acta Lund.—Acta Universitatis Lundensis, or Lunds Universitets Års-skrift. Lund, 18
Am. Chemist.—The American Chemist. New York, 1870–77. 7 vols.
Am. Ch. J.—The American Chemical Journal, edited by Remsen. Baltimore, 1879–1 50 vols.
Am. J. Sci.—American Journal of Science and Arts, edited by Silliman, Dana, and ot New Haven. 1st series, 1818–45, 50 vols.; 2nd series, 1846–70, 50 vols.; 3rd se 1871–95, 50 vols.; 4th series, 1896–1915+, 40 vols. Also numbered consecutively, vols.
Analyst.—The Analyst. London, 1876–1915+. 45 vols.
Ann. chim. farm.—Annali di chimica e di farmacologia. Milan, 1886–90. 5 vols.
Ann. des Mines.—*See* Ann. Min.
Ann. Min.—Annales des Mines. Paris.
Ann. Phil.—Annals of Philosophy. London. 1st series, 1813–20, 16 vols.; new ser 1821–26, 12 vols.
Ann. Phys.—*See* Pogg. *and* W. Ann.
Apoth. Z.—Apotheker-Zeitung. Berlin.
Arb. Kais. Gesundheitsamt.—Arbeiten aus dem Kaiserlichen Gesundheitsamte.
Arch. Néer. Sc.—Archives Néerlandaises des Sciences exactes et naturelles.
Arch. Pharm.—Archiv der Pharmacie, continued from Archiv des Apothekervereins Norddeutschland, which forms the 1st series. 1st series, 1822–34, 50 vols.; 2nd ser 1835–72, 150 vols.; 3rd series, 1873–94+, 32 vols. Also numbered consecutive which system is exclusively used after 3rd series, vol. 253 (1915).
Arch. sc. Phys. nat.—Archives des sciences physiques et naturelles de la Bibliothèc universelle de Génève.
A. Suppl.—Annalen der Chemie und Pharmacie. Supplement-Bande. Vol. i. 1861; vol. 1862–63; vol. iii. 1864–65; vol. iv. 1865–66; vol. v. 1867; vol. vi. 1868; vol. vii. 18 vol. viii. 1872.
B.—Berichte der deutschen chemischen Gesellschaft. Berlin, 1868–1915+. 48 vols.
Att. Acc. Linc.—Atti della reale accademia dei Lincei, rendconditi, etc.
B. A. B.—Sitzungsberichte der königlichen preussischen Akademie der Wissenschaften Berlin.
Belg. Acad. Bull.—Bulletin de l'Académie Royale des Sciences, des Lettres, et des Beau Arts de Belgique.
Berz. J. B.—Jahresbericht über die Fortschritte der physischen Wissenschaften, edited Berzelius. 1822–47. 30 vols.
Br. Arch.—Archiv des Apothekervereins im nördlichen Teutschland, etc., edited by Brand 1st series, 1822–31, 39 vols., corresponds to 1st series of Arch. Pharm.
Bull. Acad. Crac.—Bulletin international de l'Académie des Sciences de Cracovie.
Bull. Ac. St. Pétersb.—Bulletin de l'Académie Impériale des Sciences de St. Pétersbour
Bull. Soc.—Bulletin des Séances de la Société chimique de Paris. 2nd series, 1864–88, vols.; 3rd series, 1889–1906, 36 vols.; 4th series, 1907–15+, 18 vols.
Bull. Soc. chim. Belg.—Bulletin de la Société chimique Belgique.
Bull. Soc. ind. Mulhouse.—Bulletin de la Société industrielle de Mulhouse. 1828–49. 22 vo
Bull. Soc. Min.—Bulletin de la société française de Minéralogie. 1878–1915+. 37 vols.
C. A.—Chemical Abstracts. American Chemical Society. New York.
C. C.—Chemisches Centralblatt, continued from Pharmaceutisches Centralblatt.
C. B. Miner.—Centralblatt für mineralogie, Geologie und Palæontologie. Berlin.
Chem. Ind.—Die Chemische Industrie, edited by Jacobsen. Berlin.
Chem. Soc.—Journal of the Chemical Society of London. 1st series, 1849–62, 15 vols.; 2n series, 1863–78, 17 vols.; new series, 1878–1915+. The vols. are numbered consecutive from 1849. 1878 = vol. 32. Total, 108 vols.

Chem.-tech. Centr-Anz.—Chemisch-technischer Central-Anzeiger.
Chem. Weekbl.—Chemiker Weekblad.
Chem. Z.—*See* Ch. Z.
Chem. Zeitschr.—Chemische Zeitschrift.
Ch. Gaz.—The Chemical Gazette. London, 1843–59. 17 vols.
Ch. Kal.—Chemiker Kalender, edited by Biedermann.
Ch. Z.—Chemiker Zeitung.
Ch. Z. Repert.—Chemisches Repertorium Beiblatt zur Chemiker-Zeitung. Göthen.
Cim.—Il Cimento. Turin, 1852–54. 6 vols.
C. N.—The Chemical News. London, 1860–1915+. 112 vols.
Comm.—Commentar zur Pharmacopœa germanica by Hager. Berlin, 1883.
Compt. chim.—Comptes-rendus mensuels des Travaux chimiques, edited by Laurent and Gerhardt. 1845–51. 7 vols.
C. R.—Comptes-rendus hebdomadaires des Séances de l'Académie des Sciences. Paris, 1835–1915+. 161 vols.
Crell. Ann.—Chemische Annalen für die Freunde der Naturlehre, etc., edited by Crell. 1784–1803. 40 vols.
Dansk. Vid. For.—Oversigt over det kgl. danske Videnskabernes Selskabs Forhandlinger. Copenhagen.
Dingl.—Dingler's Polytechnisches Journal, edited by Dingler and others. 1820–1915+. 330 vols.
Edinb. Trans.—Transactions of the Royal Society of Edinburgh. 1788–1915+. 51 vols.
Ed. J. Sci.—The Edinburgh Journal of Science. 1st series, 1824–29, 10 vols.; 2nd series, 1829–32, 6 vols. Continued as Phil. Mag.
Electrochem. Ind.—Electrochemical Industry (Oct., 1902, to Dec., 1904) later Electrochemical and Metallurgical Industry. New York.
Elcktrochem Z.—Elektrochemische Zeitschrift. Berlin.
Eng. Min. J.—The Engineering and Mining Journal. New York.
Gazz. ch. it.—Gazzeta chimica italiana. Palermo, 1871–1915+. 45 vols.
Gilb. Ann.—Annalen der Physik, edited by Gilbert. 1st series, 1799–1808, 30 vols.; 2nd series, 1809–18, 30 vols.; 3rd series, 1819–24, 26 vols. Also numbered consecutively. 76 vols. Continued as Pogg.
Gm.-K.—Gmelin-Kraut's Handbuch der anorganischen Chemie, 6te Auflage. 1877–1905. 7te Auflage, 1907–1915+.
Gr.-Ot.—Graham-Otto's ausführliches Lehrbuch der anorganischen Chemie, 5te Auflage, by Michaelis. 1878–89.
Jahrb. Miner.—Jahrbuch für Mineralogie, Geologie und Palæontologie. Heidelberg. 1830–1832. Then. Neues Jahrbuch für Minerologie. Stuttgart.
Jahrb. d. Pharm.—Jahresbericht der Pharmacie.
J. Am. Chem. Soc.—Journal of the American Chemical Society. New York, 1876–1915+. 37 vols.
J. Anal. Appl. Ch.—The Journal of Analytical and Applied Chemistry, edited by Hart. 1887–93. 7 vols.
J. B.—Jahresbericht über die Fortschritte der Chemie, u. s. w.
J. Chim. méd.—Journal de Chimie médicale, de Pharmacie, et de Toxicologie. 1st series, 1825–34, 10 vols.; 2nd series, 1835–44, 10 vols.; 3rd series, 1845–54, 10 vols.; 4th series, 1855–64, 10 vols.; 5th series, 1865–76. 12 vols.
Jena. Zeit.—Jenaische Zeitschrift für Medicin und Naturwissenschaften.
J. Pharm.—Journal de Pharmacie et de Chimie. Paris. 2nd series, 1815–41, 27 vols.; 3rd series, 1842–64, 46 vols.; 4th series, 1865–79, 30 vols.; 5th series, 1879–94; 6th series, 1895–1909, 30 vols.; 7th series, 1910–15+, 10 vols.
J. Phys.—Journal der Physik, edited by Gren. 1790–98. 12 vols. Continued as Gilb. Ann.
J. Phys. Ch.—The Journal of Physical Chemistry. Ithaca, N. Y.
J. pr.—Journal für praktische Chemie, edited by Erdmann, Kolbe, and v. Meyer. Leipzig. 1st series, 1834–69, 108 vols.; 2nd series, 1870–1915+. 92 vols.
J. russ. phys. Chem. Soc.—Journal de la Société physico-chemique russe. St. Pétersbourg.
J. Russ. Soc.—Journal of the Russian Chemical Society. St. Petersburg, 1869–1915+. 47 vols.
J. Soc. Chem. Ind.—Journal of the Society of Chemical Industry. London, 1882–1915+. 34 vols.
J. S. C. I.—*See* above.
J. Tok. Chem. Soc.—Journal of the Tokyo Chemical Society.
Kastn. Arch.—Archiv für die gesammte Naturlehre, edited by Kastner. Nuremberg, 1824–35. 25 vols.
Listy Chemické.—Listy Chemické, edited by Preis and others. Prague.
Lond. R. Soc. Proc.—*See* Roy. Soc. Proc.
Lund. Univ. Arsk.—Lunds Universitets Års-skrift. Lund.

M.—Monatshefte für Chemie und verwandter Theile der anderer Wissenschaften. Vienn 1880–1915+. 36 vols.
M. A. B.—Sitzungsberichte der mathematisch-physikalischen Classe der kgl. bayerische Akademie der Wissenschaften zu München.
Mag. Pharm.—Magazin der Pharmacie. 1823–31. 36 vols.
Mém. Acad. St. Pétersb.—Mémoires de l'Académie Impériale des Sciences de Saint-Péterbourg.
M. Ch.—*See* M.
Mem. Coll. Sci. Kyoto.—Memoirs of the College of Science, Kyoto.
Metall.—Metallurgie. Halle.
Miner. Jahrb.—Neues Jahrbuch fnr Mineralogie, etc. 1833–73. 40 vols.
Miner. Mag.—Mineralogical Magazine. London.
Miner. Mitt.—Mineralogische und petrographische Mitteilungen. Wien.
Monit. Scient.—Le Moniteur Scientifique, edited by Quesnesville. Paris.
N. Arch. Sc. ph. nat.—Nouvelles Archives des Sciences physiques et naturelles. Geneva.
N. Cim:—Il nuovo Cimento. Pisa, 1855–61. 14 vols.
N. Edinb. Phil. J.—New Edinburgh Philosophical Journal. 1819–64. 90 vols.
N. Jahrb. Miner.—Neues Jahrbuch für Mineralogie. Stuttgart.
N. Jahrb. Pharm.—Neues Jahrbuch der Pharmacie. 1796–1840. 42 vols.
N. J. Pharm.—Neues Journal der Pharmacie für Aerzte, etc., edited by Trommsdorff. 1817–34. 27 vols.
N. Rep. Pharm.—Neues Repertorium für Pharmacie. 1852–76. 25 vols.
Pharm. Centralbl.—Pharmaceutisches Centralblatt. 1830–49. 20 vols. Continued as C. C.
Pharm. Era.—Pharmaceutical Era.
Pharm. J. Trans.—Pharmaceutical Journal and Transactions.
Pharm. Post.—Pharmaceutische Post. Wien.
Pharm. Verteljb.—Pharmaceutische Vierteljahresberichte.
Pharm. Weekbl.—Pharmaceutisches Weekblad.
Pharm. Ztg.—Pharmaceutische Zeitung.
Phil. Mag.—The Philosophical Magazine. London. 1st series, 1814–26, 26 vols. ; 2nd series, 1827–32, 11 vols.; 3rd series, 1832–50, 37 vols.; 4th series, 1851–75, 50 vols.; 5th series, 1876–1900, 50 vols.; 6th series, 1901–1915+, 30 vols.
Phil. Mag. Ann.—The Philosophical Magazine and Annals of Chemistry, etc. Corresponds to Phil. Mag. 2nd series.
Phil. Trans.—The Philosophical Transactions of the Royal Society of London. 1665–1915+.
Phys. Rev.—The Physical Review.
Pogg.—Annalen der Physik und Chemie, edited by Poggendorf. 1st series, 1824–43, 60 vols.; 2nd series, 1844–53, 30 vols.; 3rd series, 1854–63, 30 vols.; 4th series, 1864–73, 30 vols.; 5th series, 1874–77, 10 vols. Continued as W. Ann.
Polyt. Centralbl.—Polytechnisches Centralblatt. 1st series, 1835–46, 12 vols.; 2nd series, 1847–73, 30 vols.
Proc. Am. A. A. S.—Proceedings of the American Association for the Advancement of Science.
Proc. Am. Acad.—Proceedings of the American Academy of Arts and Sciences. Boston, 1846–1915+. 50 vols.
Proc. Am. Phil. Soc.—Proceedings of the American Philosophical Society. Philadelphia.
Proc. Chem. Soc.—Proceedings of the Chemical Society of London.
Proc. K. Akad. Wet.—See Ver. K. Akad. Wet.
Proc. Soc. Manchester.—Proceedings of the Literary and Philosophical Society of Manchester.
Proc. Roy. Soc.—*See* Roy. Soc. Proc.
Q. J. Sci.—Quarterly Journal of Science. London, 1816–26. 22 vols.
Rass. Min.—Rassegna mineraria, metallurgica e chimica.
Real. Ac. Linc.—Atti di Reale Accademia dei Lincei. Rome.
Rend. Ac. Linc. *See* Att. Ac. Linc.
Rep. anal. Ch.—Repertorium der analytischen Chemie. 1881–87. 7 vols.
Rep. Brit. Assn. Adv. Sci.—Reports of the Meetings of the British Association for the Advancement of Science.
Repert.—*See* Rep. Pharm.
Répert. chim. appl.—Répertoire de Chimie pure et appliquée. Paris, 1858–63. 9 vols.
Rep. Pharm.—Repertorium für die Pharmacie, edited by Buchner. 1st series, 1815–34, 50 vols.; 2nd series, 1835–48, 50 vols. ; 3rd series, 1849–51, 10 vols. Continued as N. Rep. Pharm.
Rev. gén. chim.—Revue génerale de chimie pure et appliquée.
Rev. Mét.—Revue de Métallurgie. Paris.
Roy. Soc. Proc.—Proceedings of the Royal Society of London. 1832–1915+. 92 vols.

Roy. Soc. Trans.—Abstracts of Philosophical Transactions of the Royal Society of London. 1832–54. 6 vols. Continued with Roy. Soc. Proc.
R. t. c.—Recueil des Travaux chimiques des Pays-Bas. Leiden, 1882–1915+. 34 vols.
Russ. Zeit. Pharm.—Pharmaceutische Zeitschrift für Russland.
Scheik Verhandel.—Scheikundige Verhandelingen en Onderzoekingen, edited by Mulder. Rotterdam, 1857–64. 3 vols.
Scher. J.—Allgemeines Journal der Chemie, edited by Scherer. 1798–1810. 17 vols. Continued as Schw. J.
Schw. J.—Journal für Chemie und Physik, edited by Schweigger. 1st series, 1811–20, 30 vols.; 2nd series, 1821–30, 30 vols.; 3rd series, 1831–33, 9 vols. Continued as J. pr.
Sill. Am. J.—American Journal of Science, edited by Silliman, etc. *See* Am. J. Sci.
Sitzungsb. böhms. Gesell.—Sitzungsberichte der königlichen böhmschen Gesellschaft der Wissenschaften in Prag.
Storer's Dict.—First Outlines of a Dictionary of Solubilities of Chemical Substances, by F. H. Storer. Boston, 1864.
Sv. V. A. F.—Öfversigt af kongl. Svenska Vetenskaps-Akademien Förhandlingar. Stockholm.
Sv. V. A. H.—Kongliga Svenska Vetenskaps-Akademiens Handlingar. Stockholm.
Sv. V. A. H. Bih.—Bihang till kongl. Svenska Vetenskaps-Akademiens Handlingar. Stockholm.
Techn. J. B.—Jahresbericht über die Fortschritte der chemischen Technologie, edited by Wagner, Fischer, etc.
Trans. Am. Electrochem. Soc.—Transactions of the American Electrochemical Society. Philadelphia.
Trans. Faraday Soc.—Transactions of the Faraday Society. London.
Trans. Roy. Soc.—Philosophical Transactions of the Royal Society of London.
Ver. K. Akad. Wet.—Verslag Koninkle Akademie van Wettenschappen, Amsterdam.
W. A. B.—Sitzungsberichte der mathematisch-naturwissenschaftlichen Classe der kaiserlichen Akademie der Wissenschaften zu Wien.
W. Ann.—Annalen der Physik und Chemie, edited by Wiedemann. Continuation of Pogg. 1877–1899. 69 vols. 4th series, 1900–1915+. 48 vols.
W. Ann. Beibl.—Beiblätter zu Wiedemann's Annalen. Leipzig.
Z. anal.—Zeitschrift für analytische Chemie, edited by Fresenius. Wiesbaden, 1862–1915+. 54 vols.
Z. anorg.—Zeitschrift für anorganische Chemie, edited by Krüss. 1892–1915+. 93 vols.
Z. B. H. Sal.—Zeitschrift für das Berg, Hütten, und Salinen-Wesen in dem preussischen Staate. Berlin.
Zeit. angew. Ch.—Zeitschrift für angewandte Chemie. Berlin, 1887–1915+. 29 vols.
Zeit. Chem.—Zeitschrift für Chemie und Pharmacie. 1st series, 1858–64, 6 vols.; 2nd series, "N. F.," 1865–71, 7 vols.
Zeit. d. allgem. öster. Apothekerv.—Zeitschrift des allgemeinen österreichischen Apothekervereins.
Zeit. ges. Nat.—Zeitschrift für die gesammten Naturwissenschaften.
Zeit. Krist.—Zeitschrift für Krystallographie und Mineralogie. 1877–1915+. 51 vols.
Zeit. Pharm.—*See* Russ. Zeit. Pharm.
Z. Elektrochem.—Zeitschrift für Elektrochemie. Halle.
Z. Phys. Ch.—Zeitschrift für physikalische Chemie, edited by Oswald and van't Hoff. 1887–1915+. 90 vols.
Z. physiol. Chem.—Zeitschrift für physiologische Chemie. Strassburg.
Z. Ver. Zuckerind.—Zeitschrift des Verein der deutschen Zuckerindustrie.

DICTIONARY

OF

CHEMICAL SOLUBILITIES

INORGANIC

Actinium emanation.

Solubility coefficient of actinium emanation in H_2O at room temp. is 2.

If the solubility of actinium emanation in H_2O is made = 1, the relative solubility of the emanation in sat. $KCl+Aq = 0.9$; in conc. $H_2SO_4 = 0.95$; in ethyl alcohol = 1.1; in amyl alcohol = 1.6; in benzaldehyde = 1.7; in benzene = 1.8; in toluene = 1.8; in petroleum = 1.9; in $CS_2 = 2.1$ at 18°.

(Hevesy, Phys. Zeit. 1911, **12.** 1221.)

Air, Atmospheric.

See also **Nitrogen** and **Oxygen.**

100 vols. H_2O at 15° and 760 mm. absorb about 5 vols. atmospheric air. (Saussure.)

1 vol. H_2O at t° and 760 mm. pressure absorbs V vols. atmospheric air reduced to 760 mm. and 0°.

t°	V	t°	V	t°	V
0	0.02471	7	0.02080	14	0.01822
1	0.02406	8	0.02034	15	0.01795
2	0.02345	9	0.01192	16	0.01771
3	0.02287	10	0.01953	17	0.01750
4	0.02237	11	0.01916	18	0.01732
5	0.02179	12	0.01882	19	0.01717
6	0.02128	13	0.01851	20	0.01701

(Bunsen's Gasometry.)

1 l. H_2O absorbs cc. N and O from air at t° and 760 mm. pressure.

t°	cc. N	cc. O	cc. N+O
0	16.09	8.62	24.71
5	14.18	7.60	21.78
10	12.70	6.79	19.49
15	11.67	6.25	17.92
20	11.08	5.93	17.01

(Bunsen, Gasometr. Methoden, 2te Aufl. 209, 220.)

1 l. H_2O absorbs cc. N and O from air at t° and 760 mm. pressure (dry).

t°	cc. N	cc. O	N+O	%O
10	15.47	7.87	23.34	33.74
15	13.83	7.09	20.92	33.86
20	12.76	6.44	19.20	33.55
25	11.78	5.91	17.69	33.40

(Roscoe and Lunt, Chem. Soc **55.** 568.)

1 l. H_2O absorbs cc. N and O from air at t° and 760 mm.

t°	cc. N	cc. O	%O
0	19.53	10.01	33.88
6.0	16.34	8.28	33.60
6.32	16.60	8.39	33.35
9.18	15.58	7.90	33.60
13.70	14.16	7.14	33.51
14.10	14.16	7.05	33.24

(Pettersson and Sondén, B. **22.** 1439.)

1 l. H_2O absorbs cc. N (0° and 760 mm.) from atmospheric air at t° and 760 mm. pressure (dry).

t°	cc. N	t°	cc. N	t°	cc. N
0	19.14	10	15.14	20	12.63
2	18.20	12	14.53	22	12.27
4	17.34	14	13.98	24	11.95
6	16.54	16	13.48	25	11.81
8	15.81	18	13.03	..	..

(Hamberg, J. pr. (2) **33.** 447.)

1 l. H_2O absorbs cc. N from air at t° an 760 mm. pressure.

t°	cc. N	t°	cc. N	t°	cc. N
0	19.29	10	15.36	20	12.80
5	17.09	15	13.95	25	11.81

(Dittmar, Challenger Expedition, vol. **1.** pt. 1.)

1 l. H_2O sat. with air at t° and 760 mm. contains cc. O (red. to 0° and 760 mm.).

t°	cc. O	t°	cc. O	t°	cc. O
0	10.187	11	7.692	22	6.114
1	9.910	12	7.518	23	5.999
2	9.643	13	7.352	24	5.886
3	9.387	14	7.192	25	5.776
4	9.142	15	7.038	26	5.669
5	8.907	16	6.891	27	5.564
6	8.682	17	6.730	28	5.460
7	8.467	18	6.614	29	5.357
8	8.260	19	6.482	30	5.255
9	8.063	20	6.356	..	...
10	7.873	21	6.233	..	...

(Winkler, B. **22.** 1773.)

1 vol. H_2O absorbs 0.01748 vol. air at 24.05° and 760 mm. pressure. (Winkler, B. **21.** 2851.)

Composition of the absorbed air between 0° and 24° is 34.91% O and 65.09% N (Bunsen); between 15° and 16°, 32.17% O and 67.83% N (König and Kranch, Z. anal. **19.** 259); 32% O and 68% N (Regnault); at 0°, 35.1% O; 10°, 34.8% O; 20°, 34.3% O; 25°, 33.7% O (Winkler, B. **21.** 2483). See also Roscoe and Lunt, and Pettersson and Sondén, page 1.

Solubility of atmos. oxygen and nitrogen in 1000 cc. H_2O at 760 mm. pressure (calc.).

Temp	Oxygen	Nitrogen	Temp	Oxygen	Nitrogen
	cc.	cc.		cc.	cc.
0°	10.19	18.45	29°	5.33	10.30
1	9.91	17.99	30	5.24	10.15
2	9.64	17.55	31	5.15	9.99
3	9.39	17.12	32	5.07	9.83
4	9.14	16.71	33	4.99	9.67
5	8.91	16.30	34	4.91	9.52
6	8.68	15.91	35	4.83	9.37
7	8.47	15.54	36	4.76	9.22
8	8.26	15.18	37	4.69	9.08
9	8.06	14.83	38	4.62	8.94
10	7.87	14.50	39	4.55	8.81
11	7.69	14.19	40	4.48	8.67
12	7.52	13.89	41	4.42	8.55
13	7.35	13.61	42	4.35	8.43
14	7.19	13.33	43	4.28	8.31
15	7.04	13.07	44	4.22	8.20
16	6.89	12.83	45	4.15	8.09
17	6.75	12.57	46	4.09	7.97
18	6.61	12.34	47	4.03	7.87
19	6.48	12.12	48	3.97	7.76
20	6.35	11.91	49	3.91	7.65
21	6.23	11.71	50	3.85	7.55
22	6.10	11.52	51	3.79	7.45
23	5.98	11.33	52	3.74	7.34
24	5.86	11.14	53	3.68	7.24
25	5.75	10.96	54	3.62	7.13
26	5.64	10.79	55	3.56	7.03
27	5.54	10.62	56	3.51	6.92
28	5.43	10.46	57	3.45	6.81

Solubility of atmos. etc.—*Continued*

Temp	Oxygen	Nitrogen	Temp	Oxygen	Nitroge
	cc.	cc.		cc.	cc.
58°	3.39	6.71	80°	1.97	4.03
59	3.34	6.60	81	1.89	3.88
60	3.28	6.50	82	1.81	3.73
61	3.22	6.39	83	1.73	3.57
62	3.16	6.27	84	1.65	3.41
63	3.10	6.16	85	1.57	3.24
64	3.04	6.05	86	1.48	3.07
65	2.98	5.94	87	1.39	2.89
66	2.92	5.82	88	1.30	2.71
67	2.85	5.70	89	1.21	2.52
68	2.79	5.59	90	1.11	2.32
69	2.73	5.47	91	1.02	2.12
70	2.66	5.35	92	0.92	1.91
71	2.60	5.23	93	0.81	1.70
72	2.53	5.10	94	0.71	1.48
73	2.47	4.98	95	0.60	1.25
74	2.40	4.85	96	0.48	1.01
75	2.33	4.72	97	0.37	0.77
76	2.26	4.59	98	0.27	0.52
77	2.19	4.45	99	0.13	0.27
78	2.12	4.32	100	0.00	0.00
79	2.04	4.18			

(Winkler, B. 1901, **34.** 1440.)

Absorption of atmospheric air by H_2O at and 760 mm. pressure. β = coefficient absorption. β_1 = "Solubility." (S under oxygen.)

t°	β	β_1	t°	β	β_1
0	0.02881	0.02864	55	0.01253	0.010
5	2543	2521	60	1216	09
10	2264	2237	65	1182	08
15	2045	2011	70	1156	08
20	1869	1826	75	1137	07
25	1724	1671	80	1126	06
30	1606	1539	85	1119	04
35	1503	1420	90	1113	03
40	1418	1315	95	1109	01
45	1351	1224	100	1105	00
50	1297	1140			

(Winkler, B. 1901, **34.** 1409.)

Sea-water absorbs less O and N from than pure H_2O, but the ratio between O and remains constant. In sea-water sat. with at 6.22° the oxygen was 33.50% of the tot gas absorbed. (Pettersson and Sondén.)

1 l. sea-water absorbs cc. N and O from at t° and 760 mm. pressure.

t°	cc. N	cc. O	N+O	% O
0	14.41	7.77	22.18	35.03
5	13.22	6.93	20.15	34.39
10	12.08	6.29	18.37	34.24
15	11.01	5.70	16.71	34.11

(Tornoë, Norwegian North Atlantic Expe Chem. 18.)

1 l. sea water absorbs cc. N from air at t° and 760 mm.

t°	cc. N	t°	cc. N	t°	cc. N
0	15.60	10	12.47	20	10.41
5	13.86	15	11.34	25	9.62

(Dittmar.)

1 l. sea-water absorbs cc. N (0° and 760 mm.) from atmospheric air at t° and 760 mm. pressure (dry).

t°	cc. N	t°	cc. N	t°	cc. N
0	14.85	10	12.06	20	10.25
2	14.20	12	11.62	22	9.98
4	13.60	14	11.23	24	9.73
6	13.04	16	10.87	25	9.62
8	12.53	18	10.54	..	...

(Hamberg.)

Absorption of air which is free from carbonic acid by H_2SO_4 at 18° and 760 mm. α = coefficient of solubility.

H_2SO_4	α	H_2SO_4	α
98%	0.0173	70%	0.0055
90%	0.0107	60%	0.0059
80%	0.0069	50%	0.0076

(Tower, Z. anorg. 1906, **50**, 388.)

Absolute alcohol absorbs 0.11 vol. gas from air, 1/3 of which is O and 2/3, N. On mixing with an equal vol. H_2O, 2/3 of the dissolved gas is given off. (Döbereiner.)

100 vols. alcohol (95.1 %) absorb 14.1 vols. air. (Robinet, C. R. **58.** 608.)

100 vols. petroleum	absorb	6.8	vols. air.
" " oil of lavender	"	6.89	" "
" " benzene	"	14.0	" "
" " oil of turpentine	"	24.18	" "

(Robinet, *l.c.*)

1 vol. ether at 760 mm. pressure absorbs 0.290 vols. air at 0°; 0.287 vols. at 10°; 0.286 vols. at 15°. (Christoff, Z. phys. Ch. 1912, **79.** 459.)

Alcohol. C_2H_5OH.

Sp. gr. of pure ethyl alcohol+Aq. at 25°.

% alcohol	Sp. gr.	% alcohol	Sp. gr.
0	0.997077	55	0.898502
2	0.993359	60	0.886990
5	0.988166	65	0.875269
6	0.986563	70	0.863399
10	0.980434	75	0.851336
15	0.973345	80	0.839114
20	0.966392	85	0.826596
25	0.958946	90	0.813622
30	0.950672	95	0.799912
35	0.941459	98	0.791170
40	0.931483	99	0.788135
45	0.920850	100	0.785058
50	0.909852	—	—

(Osborne, McKelvy and Bearce, Bureau of Standards, Sci. Paper No. 197.)

Alum, Ammonia.

See **Sulphate, aluminum ammonium.**

Alum, Chrome.

See **Sulphate, aluminum chromium.**

Alum, Iron.

See **Sulphate, aluminum ferric.**

Alum, Potash.

See **Sulphate, aluminum potassium.**

Alumina.

See **Aluminum oxide.**

Aluminic acid, $H_2Al_2O_4 = Al_2O_3, H_2O$.

Aluminum hydroxide possesses acid properties, and salts corresponding to an acid of the above formula exist.

See **Aluminum hydroxide.**

Aluminates.

All aluminates are insol. in H_2O except those of K and Na (Fremy) and Ba (Beckmann, J. pr. (2) **26.** 385).

Barium aluminate, $BaAl_2O_4+4H_2O$.

Sol. in 10 pts. H_2O; can be recryst. from alcohol. (Deville, J. pr. **87.** 299.)

$+5H_2O$. Sl. sol. in H_2O with decomp. (Allen, Am. Ch. J. 1900, **24.** 313.)

$+7H_2O$. Sl. sol. in cold, not completely sol. in hot H_2O. Sol. in cold dil. HCl+Aq. (Beckmann, J. pr. (2) **26.** 385.)

$Ba_2Al_2O_5+5H_2O$. Sol. in 20 pts. H_2O by boiling. (Beckmann, B. **14.** 2151.)

Insol. in alcohol.

Sl. sol. in H_2O with decomp.; insol. in alcohol. (Allen, Am. Ch. J. 1900, **24.** 311.)

$Ba_3Al_2O_6+7-11H_2O$. Sol. in 15 pts. H_2O with decomp. into $Ba_2Al_2O_5+5H_2O$; insol. in alcohol. (Beckmann.)

Barium aluminate bromide, $BaAl_2O_4, BaBr_2+11H_2O$.

Sol. in H_2O. (Beckmann, J. pr. (2) **26.** 385, 474.)

Barium aluminate chloride, $BaAl_2O_4, 3BaCl_2+6H_2O$.

Sol. in H_2O. (Beckmann, l.c.)

$BaAl_2O_4, BaCl_2+11H_2O$. Sol. in H_2O. (Beckmann, l.c.)

Barium aluminate iodide, $BaAl_2O_4, BaI_2$.

Sol. in H_2O. (Beckmann, l.c.)

Calcium aluminate, CaO, Al_2O_3.

Decomp. by H_2O but does not "set." Sol. in HCl; insol. in HNO_3, H_2SO_4, and HF. (Dufau, C. R. 1900, **131.** 543.)

$Ca_2Al_2O_5+7H_2O$. Slowly decomp. by H_2O; sl. sol. in H_2O. (Allen, Am. Ch. J. 1900, **24.** 316.)

$Ca_3Al_2O_6$. Insol. in H_2O; not decomp. by KOH+Aq; sol. in acids. (Tissier, C. R. **48.** 627.)

$+6H_2O$. Ppt; sl. sol. in H_2O; insol. in alcohol. (Allen, Am. Ch. J. 1900, **24.** 316.)

$3Al_2O_3.4CaO+3H_2O$. Ppt. (Friedel, Bull. Soc. Min. 1903, **26.** 121; C. C. **1904,** I. 430.)

Cobalt aluminate.

"*Thenard's* or *Leithner's* blue." Insol. in H_2O.

$CoAl_2O_4$. Insol. in H_2O and acids. (Ebelmen.)

Cobalt magnesium aluminate, $[MgCo]Al_2O_4$.

"*Spinel Blue.*" Insol. in H_2O or $HCl+Aq$. (Ebelmen.)

Glucinum aluminate, $GlAl_2O_4$.

Min. *Chrysoberyll.* Not attacked by acids, but decomp. by $KOH+Aq$.

Iron (ferrous) aluminate, $FeAl_2O_4$.

Min. *Hercynite.* Not attacked by acids.

Lithium aluminate, $LiAlO_2$.

Sol. in H_2O. (Weyberg, C. C. **1906,** II. 1659.)

Lithium hydrogen aluminate, $LiHAl_2O_4+5H_2O$.

Sl. sol. in H_2O; decomp. on boiling. (Allen, Am. Ch. J. 1900, **24.** 310.)

Magnesium aluminate, $MgAl_2O_4$.

Min. *Spinel.* Insol. in H_2O.

Insol. in HNO_3+Aq; very sl. sol. in $HCl+Aq$; partly sol. in H_2SO_4 at boiling temp. (Abich, Pogg. **23.** 316.)

Sol. by standing 2 hours at 210° with a mixture of 3 pts. H_2SO_4 and 1 pt. H_2O, or by boiling with this mixture together with HF. (Mitscherlich, J. pr. **81.** 108.)

Sl. sol. in HCl, HF, and H_2SO_4; insol. in HNO_3. (Dufau, Bull. Soc. 1901, (3) **25.** 669.)

Manganous aluminate.

Insol. in H_2O and acids. (Ebelmen, A. ch. (3) **22.** 225.)

$MnAl_2O_4$. Insol. in $HCl+Aq$; readily attacked by HF, HNO_3 and H_2SO_4.

Decomp. by fusion with alkali chlorate, nitrate, oxide or carbonate. (Dufau, C. R. 1902, **135.** 963.)

Nickel aluminate.

Insol. in H_2O.

Potasssium aluminate, $K_2Al_2O_4+3H_2O$.

Decomp. by dissolving in pure H_2O with separation of Al_2O_3. (Fremy, A. ch. (3). **12.** 362.) Can be recrystallised from water containing a little alkali, without decomposition. (Fremy.)

Insol. in alcohol.

Sodium aluminate, $Na_2Al_2O_4$.

Easily and completely sol. in cold H_2O. (Schaffgotsch, Pogg. **43.** 117.)

$+4H_2O$. Insol. in alcohol. (Allen, Am. Ch. J. 1900, **24.** 308.)

$Na_6Al_2O_6$. Miscible with hot H_2O, and as sol. as NaOH in cold H_2O. Insol. in alcohol but decomp. thereby. (Tissier, C. R. **43.** 102.)

Strontium aluminate, $Sr_3Al_2O_6+6H_2O$.

Sl. sol. in H_2O (with slow decomp. in Aq. solution). (Allen, Am. Ch. J. 1900, **24.** 314.)

Thallium aluminate, $Tl_4Al_2O_5+7H_2O$.

Not completely sol. in, but slowly hydrolysed by H_2O.

Readily sol. in dil. acids and in the fixed alkalies.

Insol. in abs. alcohol. (Hawley, J. Am. Chem. Soc. 1907, **29.** 303.)

Zinc aluminate, $ZnAl_2O_4$.

Insol. in acids or alkalies.

Min. *Gahnite* (*Automolite*).

$+xH_2O$. Sol. in KOH, and NH_4OH+Aq. (Berzelius.)

Aluminicoantimoniotungstic acid.

Ammonium aluminicoantimoniotungstate, $6(NH_4)_2O$, $2Al_2O_3$, $3Sb_2O_5$, $18WO_3+17H_2O$.

A shellac-like gum. (Daniels, J. Am. Chem. Soc. 1908, **30.** 1856.)

Barium aluminicoantimoniotungstate, $5BaO$, $2Al_2O_3$, $3Sb_2O_5$, $18WO_3+6H_2O$.

Somewhat insol. in dil. HCl. (Daniels, J. Am. Chem. Soc. 1908, **30.** 1857.)

Silver aluminicoantimoniotungstate, $6Ag_2O$, $2Al_2O_3$, $3Sb_2O_5$, $18WO_3+12H_2O$.

Ppt.

Sol. in NH_4OH+Aq but requires HNO_3 (1:10) to dissolve it. (Daniels, J. Am. Chem. Soc. 1908, **30.** 1857.)

Aluminicoarseniotungstic acid.

Ammonium aluminicoarseniotungstate, $6(NH_4)_2O$, $2Al_2O_3$, $3As_2O_5$, $18WO_3+14H_2O$.

Sparingly sol. in H_2O. (Daniels, J. Am. Chem. Soc. 1908, **30.** 1854.)

Barium aluminicoarseniotungstate, $4BaO$, $2Al_2O_3$, $3As_2O_5$, $18WO_3+12H_2O$.

Very sl. sol. in H_2O.

Sol. in very dil. HCl or HNO_3. (Daniels, J. Am. Chem. Soc. 1908, **30.** 1855.)

Cadmium aluminicoarseniotungstate, $4CdO$, $2Al_2O_3$, $3As_2O_5$, $18WO_3+17H_2O$.

Sol. in dil. mineral acids and in strong NH_4OH+Aq. (Daniels, J. Am. Chem. Soc. 1908, **30.** 1855.)

Aluminicomolybdic acid.

Ammonium aluminicomolybdate, $3(NH_4)_2O$, Al_2O_3, $12MoO_3+19H_2O$.

Ppt. (Hall, J. Am. Chem. Soc. 1907, **29.** 696.)

$+20H_2O$. More sol. in H_2O than potassium

aluminicomolybdate. (Struve, Bull. Acad. St. Petersb. **12.** 147.)

$+22H_2O$. (Marckwald, Dissert. **1895.**)

Barium aluminicomolybdate, $4BaO, Al_2O_3, 12MoO_3+14H_2O$.

Ppt. (Hall, J. Am. Chem. Soc. 1907, **29.** 712.)

Lead aluminicomolybdate, $4PbO, Al_2O_3, 12MoO_3+21H_2O$.

Ppt. (Hall, J. Am. Chem. Soc. 1907, **29.** 712.)

Potassium aluminicomolybdate, $3K_2O, Al_2O_3, 12MoO_3+20H_2O$.

1 pt. of the salt is sol. in 40.67 pts. H_2O at 17°. Very difficultly sol. in acids. (Struve.)

$H_3Al(MoO_4)_3, 2KHMoO_4$. Sol. in H_2O. (Parmentier, C. R. **94.** 1713.)

Silver aluminicomolybdate, $4Ag_2O, Al_2O_3, 12MoO_3+16H_2O$.

Ppt. (Hall, J. Am. Chem. Soc. 1907, **29.** 712.)

Sodium aluminicomolybdate, $3Na_2O, Al_2O_3, 12MoO_3+22H_2O$.

Efflorescent. Easily sol. in H_2O. (Gentele J. pr. **81.** 413.)

Aluminicophosphotungstic acid.

Ammonium aluminicophosphotungstate, $9(NH_4)_2O, 2Al_2O_3, 4P_2O_5, 9WO_3+13H_2O$.

Sl. sol. in cold and in hot H_2O. (Daniels, J. Am. Chem. Soc. 1908, **30,** 1851.)

Barium aluminicophosphotungstate, $4BaO, 2Al_2O_3, 4P_2O_5, 9WO_3+13H_2O$.

Sl. sol. in H_2O. Sol. in very dil. HCl or HNO_3. (Daniels, J. Am. Chem. Soc. 1908, **30.** 1853.)

Silver aluminicophosphotungstate, $4Ag_2O, 2Al_2O_3, 4P_2O_5, 9WO_3+6H_2O$.

Nearly insol. in H_2O. Sol. in NH_4OH and in dil. HNO_3. Insol. in acetic acid. (Daniels, J. Am. Chem. Soc. 1908, **30.** 1852.)

Zinc aluminicophosphotungstate, $5ZnO, 2Al_2O_3, 4P_2O_5, 9WO_3+11H_2O$.

Sol. in dil. acids and in a large quantity of conc. ammonia when NH_4Cl is present. (Daniels, J. Am. Chem. Soc. 1908, **30.** 1853.)

Aluminicotungstic acid.

Ammonium aluminicotungstate, $3(NH_4)_2O, Al_2O_3, 9WO_3+4H_2O$.

Sol. in conc. HNO_3 and in conc. HCl. When the solution in conc. HCl was boiled, a yellow colored ppt. separated. (E. F. Smith, J. Am. Chem. Soc. 1903, **25.** 1230.)

Ammonium silver alumininicotungstate, $11Ag_2O, 21(NH_4)_2O, 4Al_2O_3, 36WO_3$.

The dry salt is insol. in pure H_2O, but readily sol. in H_2O containing NH_3 or HNO_3. (E. F. Smith, J. Am. Chem. Soc. 1903, **25.** 1231.)

Barium aluminicotungstate, $8BaO, Al_2O_3, 9WO_3+7H_2O$.

Not sol. in acids when dry. Somewhat decomp. by boiling with conc. HCl, HNO_3 or aqua regia. (Daniels, J. Am. Chem. Soc. 1908, **30.** 1848.)

Copper aluminicotungstate, $2CuO, Al_2O_3, 9WO_3+16\frac{1}{2}H_2O$.

Sol. in large quantities of H_2O. (Daniels, J. Am. Chem. Soc. 1908, **30.** 1847.)

Mercurous aluminicotungstate, $5Hg_2O, Al_2O_3, 9WO_3$.

Sl. sol. in H_2O. Sol. in HNO_3(1:5). (Daniels, J. Am. Chem. Soc. 1908, **30.** 1849.)

Zinc aluminicotungstate, $1\frac{1}{2}ZnO, Al_2O_3, 9WO_3+8H_2O$.

Insol. in H_2O. (Daniels, J. Am. Chem. Soc. 1908, **30.** 1850.)

$ZnO, Al_2O_3, 9WO_3+20H_2O$. Sol. in H_2O. (Daniels.)

Aluminum, Al.

Less easily attacked than ordinary metals (iron, copper, lead, zinc, tin) by air, H_2O, wine, beer, coffee, milk, oil, butter, fats, etc. Vinegar dissolves 0.349 g. from a sq. decimetre in 4 months, and 5 % NaCl+Aq, only 0.045 g. in the same time. (Ballaud, C. R. **114.** 1536.)

The action of various substances contained in foods and drinks on compact Al as it occurs in utensils is very slight. Hard or soft water, whether cold or hot, showed no action in 8 days; 1 % solutions of tartaric, tannic, and acetic acids had no action in same time, also 5 % boric, carbolic, and salicylic acids. 4 % and 10 % acetic acid dissolved only 0.4 mg. of Al, while 10 % acetic acid dissolved 2.1 mg. from a roughened piece of Al foil in 8 days. 1 % soda solution dissolved 15 mg. in 8 days. (Rupp, Dingl. **283.** 119.)

Similar results were obtained by Arche. (Dingl. **284.** 255.)

Liquids which are ordinarily contained in foods and drinks do not attack sheet Al except in a very small degree. The following losses in weight in mg. by the action of the given liquids on 100 sq. centimetres sheet aluminum for 6 days were obtained:

Liquids	Loss in mg.
Claret	2.84
Hock	3.27
Brandy	1.08
5 % alcohol	0.61
5 % tartaric acid+Aq	1.69
1 % " "	2.58
5 % acetic acid+Aq	3.58
1 % " "	4.38

Liquids	Loss in mg.
5 % citric acid+Aq . .	2.15
1 % " " . .	1.90
5 % lactic acid+Aq . .	4.77
5 % butyric acid+Aq . .	1.31
Coffee	0.50
Tea	0
Beer	0
4 % boric acid+Aq . .	1.77
5 % carbolic acid+Aq . .	0.23
1 % " " . .	0.49
½ % salicylic acid+Aq .	6.35

(Lunge, C.N. **65.** 110.)

The apparent solubility of this metal in H_2O is due to the presence of minute quantities of Na. Absolutely pure Al does not lose any weight to H_2O and the H_2O remains perfectly clear. Also dil. acids remain perfectly clear. (Moissan, C. R. 1895, **121.** 794–98; C. C. **1896,** I. 193.)

Sl. attacked by H_2O at 80°. (W. Smith, J. Soc. Chem. Ind. 1904, **23.** 475.)

Easily sol. in dil. or conc. HCl+Aq, whether hot or cold; also in HBr, HI, or HF+Aq. Insol. in dil. H_2SO_4+Aq (de la Rive); sl. attacked by cold, easily by hot conc. H_2SO_4. Not attacked by HNO_3+Aq even when conc. and boiling (Wöhler); easily sol. in dil. H_2SO_4, or HNO_3+Aq in vacuo (Weeren, B. **24.** 1798); slowly sol. in 27 % HNO_3+Aq, 100 ccm. HNO_3+Aq requiring 2 months to dissolve 2 g. Al (Montemartini, Gazz. ch. it. **22.** 397); very sl. sol. in most organic acids, but solubility is increased by presence of NaCl.

Not attacked by dil. or conc. HNO_3 at ord. temp. but attacked by hot HNO_3. Attacked by H_3PO_4. (Smith, J. Soc. Chem. Ind. 1904, **23.** 475.)

Completely sol. at 100° in two hours in HNO_3, sp. gr. 1.15–1.46. (Stillman, J. Am. Chem. Soc. 1897, **19.** 714.)

Very easily sol. in HNO_3 (contrary to the usual statement in text-books). (Woy, C. C. **190** , II. 94.)

Slowly attacked by HNO_3+Aq (20–25 %) at 25–30°. (Deventer, Chem. Weekbl. 1907, **4.** 69.)

Dil. HNO_3 or H_2SO_4 does not attack Al on account of formation of layer of gas. Action is increased by vacuum. Solutions of metallic chlorides, the metal of which is insol. and attaches itself to the Al (Pt, Au, Cu, Hg) increase the solubility, but when metal is soluble in the acid (Fe, Zn, etc.), there is no increase of solubility. (Ditte, C. R. 1890, **110.** 573.)

Violently attacked by dil. or conc. H_3PO_4+Aq. (Winteler.)

Not attacked by solution of HCl in liquid HCN. (Kahlenberg, J. phys. Chem. 1902, **6.** 662.)

Very easily sol. in conc. or dil. KOH, or NaOH+Aq. Slowly attacked by NH_4OH+Aq (Wohler); sol. in BaO_2H_2+Aq (Beckmann, J. pr. (2) **26.** 385); slowly sol. in CaO_2H +Aq.

Sol. in excess of 10 % KOH+Aq and i NaOH and LiOH+Aq; sol. in hot conc $Ba(OH)_2$, $Sr(OH)_2$ and $Ca(OH)_2$+Aq. (Allen Am. Ch. J. 1900, **24.** 304–331.)

Attacked by hot conc. NH_4OH+Ac (Smith, J. Soc. Chem. Ind. 1904, **23.** 475.)

Sl. attacked by sulphates, or nitrates+Aq but all chlorides, bromides, and iodides, excep those of the alkalies and alkaline earths, eve $AlCl_3$+Aq, dissolve the metal. Insol. i alum, or in NaCl+Aq, but sol. in alum-NaCl+Aq. (Tissier, C. R. **41.** 362); sol. i NaCl+Aq (Deville, A. ch. (3) **43.** 14); so in neutral $FeCl_3$+Aq in vacuo. (Weeren B. **24.** 1798.) Violently attacked by $CuCl_2$-Aq. (Tommasi, Bull. Soc. (2) **37.** 443.)

Rapidly sol. in $K_2S_2O_8$+Aq, more slowl sol. in $(NH_4)_2S_2O_8$+Aq. (Levi, Gazz. ch. i 1908, **38.** (1) 583.)

Attacked by $(NH_4)_3PO_4$+Aq. Sl. attacke by $NaNO_3$+Aq or KNO_3+Aq at 100 (Smith, J. Soc. Chem. Ind. 1904, **23.** 475.)

Not affected by NH_4NO_3+Aq. (Hodgkinson, C. N. 1904, **90.** 142.)

Attacked by $POCl_3$ at 100°. (Renitzer, B **13.** 845.)

Insol. in liquid NH_3. (Gore, Am. Ch. J 1898, **20.** 826.)

Insol. in liquid CO_2. (Büchner, Z. phys Ch. 1906, **54.** 674.)

Attacked by NOCl. (Sudborough, Chem Soc. 1891, **59.** 659.

92 %alcohol attacks Al less than H_2O. Pur Al is attacked less than commercial. (Hugounenq, J. Pharm. 1895, (6) **1.** 537.)

Sol. in organic acids containing chlorides (Smith, J. Soc. Chem. Ind. 1904, **23.** 475.)

Acetic, tartaric and citric acids attack A only at first. Metal is covered by layer c hydroxide but on addition of haloid salts gradual solution ensues. (Ditte, C. R. 189 **127.** 919.)

Not attacked by sugar+Aq. (Klein, C. R **102.** 1170.)

Aluminum arsenide.

Decomp. by H_2O with evolution of AsH (Wöhler, Pogg. **11.** 160.)

Decomp. by H_2O. (Fonzes-Diacon, C. R 1900, **130.** 1315.)

Aluminum boride, Al_2B_4.

Very slowly sol. in hot conc. HCl+Aq, an hot NaOH+Aq, but easily in moderatel strong warm HNO_3+Aq. (Hampe, A. **18** 75.)

Al_2B_{24}. Not attacked by HCl, or KOH-Aq. Scarcely attacked by boiling H_2SO Hot conc. HNO_3+Aq dissolves gradually bu completely. (Hampe, l. c.)

Aluminum borocarbide, $Al_3C_2B_{48}$.

Insol. in H_2O, HCl+Aq, H_2SO_4+Aq,

$KOH+Aq$; slowly sol. in hot conc. HNO_3+Aq. (Hampe, l. c.)

Aluminum bromide, $AlBr_3$.

Anhydrous. Dissolved by H_2O with great violence and evolution of much heat. Very sol. in alcohol. More sol. in CS_2 than AlI_3. (Weber, Pogg. **103.** 264.)

Sol. in $SOCl_2$. (Besson, C. R. 1896, **123.** 884.)

Sol. in C_2H_5Br. (Plotnikoff, C. C. **1902,** II. 617.)

Sol. in acetone. (Naumann, B. 1904, **37.** 4328); (Eidmann, C. C. **1899,** II. 1014.)

Solubility of $AlBr_3$ in organic liquids.

Solvent	t°	Mols. per 100	t°	Mols. per 100	t°	Mols. per 100
Benzophenone	48°	0	130°	43.2	50°	66.0
	45	8.5	140	48.4	38	67.2
	42	13.8	142	50	50	70.7
	38	18.3	140	52.1	60	74.2
	50	21	130	54.5	70	78.3
	60	23.4	120	56.7	80	83.3
	70	25.7	110	58.6	85	86.7
	80	28.1	100	60.3	90	90.7
	90	30.6	90	61.7	93	94.8
	100	33.4	80	62.9	96	100
	110	36.3	70	64.1		
	120	39.6	60	65.1		
Ethylene bromide	10°	0	20°	33.9	70°	72.7
	6	8.4	30	40.1	80	82.3
	2	16.0	40	47.2	90	92.2
	—2	22.9	50	55.1	96	100
	10	28.4	60	63.6		
Benzoyl chloride	—0.5°	0	85°	47	40°	72.6
	—2.5	6.5	90	50.8	60	79.4
	—5	13.0	80	52.8	70	83.9
	10	17.4	60	56	80	89.2
	30	24.6	40	59.5	90	95.8
	50	31.8	20	63.1	96	100
	70	40	7	65.5		
	80	44.3	20	67.9		

(Menschutkin, Ann. Inst. Pol. P.-le-Gr., **13.** 1.)

$+6H_2O$. Very sol. in H_2O.
$+15H_2O$. (Panfiloff, J. B. **1895.** 785.)

Aluminum antimony bromide, $2AlBr_3, 5SbBr_5 +24H_2O$.

Hygroscopic. Decomp. by H_2O. (Weinland, B. 1903, **36.** 258.)

Aluminum potassium bromide, $AlBr_3, KBr$.

Sol. in H_2O. (Weber, Pogg. **103.** 267.)

Aluminum bromide ammonia, $AlBr_3, xNH_3$.

Decomp. by H_2O. (Weber, Pogg. **103.** 267.)

Aluminum *per*bromide carbon *bi*sulphide, $AlBr_3, Br_4, CS_2$.

Sol. in ether, ethyl bromide, ethylene bromide and benzene; decomp. by H_2O. (Plotnikoff, J. Russ. phys. Chem. Soc. 1901, **33.** 91; C. C. **1901,** I. 1193.)

$2AlBr_3, Br_4, CS_2$. Sol. in ether and benzene; insol. in petroleum ether. (Plotnikoff, *l. c.*)

Aluminum bromochloride, $AlCl_2Br$.

Deliquescent. Somewhat less violently dissolved by H_2O than is $AlBr_3$. (v. Bartal, Z. anorg. 1907, **55.** 154.)

$+6H_2O$. Deliquescent. Sol. in H_2O without evolution of heat. (v. Bartal, Z. anorg. 1907, **55.** 155.)

Aluminum carbide, Al_4C_3.

Decomp. by fused KOH at 100°; insol. in fuming HNO_3 in the cold; decomp. by H_2O, and dil. acids. (Moissan, Bull. Soc. 1894, (3) **11.** 1012; C. R. 1894, **119.** 16–20.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4328.)

Aluminum chloride, basic, $Al_8O_{14}H_{10}$, HCl.

Easily sol. in H_2O. (Schlumberger, Bull. Soc. 1895, (3) **13.** 56.)

Aluminum chloride, $AlCl_3$.

Anhydrous. Very deliquescent. Sol. in H_2O with a hissing noise and evolution of heat. Solution of $AlCl_3$ in H_2O loses HCl on evaporation, and $AlCl_3$ is finally wholly converted into Al_2O_3.

Sol. in 1.432 pts. H_2O at 15°. (Gerlach.)

$AlCl_3+Aq$ containing 19.15 % $AlCl_3$ boils at 103.4°; $AlCl_3+Aq$ containing 38.3 % $AlCl_3$ boils at 112.8°. (Gerlach.)

Sp. gr. of $AlCl_3+Aq$ at 15°.

% $AlCl_3$	Sp. gr.	% $AlCl_3$	Sp. gr.
1	1.0072	22	1.1709
2	1.0144	23	1.1795
3	1.0216	24	1.1881
4	1.0289	25	1.1968
5	1.0361	26	1.2058
6	1.0435	27	1.2149
7	1.0510	28	1.2241
8	1.0585	29	1.2331
9	1.0659	30	1.2422
10	1.0734	31	1.2518
11	1.0812	32	1.2615
12	1.0890	33	1.2711
13	1.0968	34	1.2808
14	1.1047	35	1.2905
15	1.1125	36	1.3007
16	1.1207	37	1.3109
17	1.1290	38	1.3211
18	1.1372	39	1.3313
19	1.1455	40	1.3415
20	1.1537	41	1.3522
21	1.1632		

(Gerlach, Z. anal. **8.** 281.)

Sp. gr. at 20° of $AlCl_3$+Aq containing mg. mols. $AlCl_3$ per liter.

M.	Sp. gr.
0.01	1.00104
0.025	1.00282
0.05	1.00588
0.075	1.00870
0.10	1.01158
0.25	1.02911
0.55	1.05706
1.0	1.11054
1.5	1.16308
2.0	1.21378

(Jones & Pearce, Am. Ch. J. 1907, **38.** 726.)

Sol. in 1 pt. strong alcohol at 12.5° (Wenzel); easily sol. in ether; sl. sol. in CS_2; insol. in ligroine or benzene.

Difficultly sol. in $AsBr_3$. (Walden, Z. anorg. 1902, **29.** 374.)

Sol. in $AlBr_3$. (Isbekow, Z. anorg. 1913, **84.** 26.)

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 826.)

Insol. in CS_2 at ord. temp. (Arctowski, Z. anorg. 1894, **6.** 257.)

Sol. in benzonitrile. (Naumann, B. 1914, **47.** 1369.)

Difficultly sol. in acetone. (Naumann, B. 1904, **37.** 4328.)

Insol. in ethyl acetate. (Naumann, B. 1910, **43.** 314.)

Insol. in methylal. (Eidmann, C. C. **1899,** II. 1014.)

Solubility of $AlCl_3$ in organic liquids.

Solvent	t°	Mols. per 100	t°	Mols. per 100	t°	Mols. per 100
Benzophenone	48°	0	130°	43.2	130°	66.0
	44	8.5	125	48.4	140	67.2
	39.5	13.8	120	50	150	70.7
	50	18.3	110	52.1	160	74.2
	60	21.	100	54.5	170	78.3
	70	23.4	90	56.7	180	83.3
	80	25.7	80	58.6	185	86.7
	90	28.1	70	60.3	190	90.7
	100	30.6	60	61.7	192	94.8
	110	33.4	80	62.9	194	100
	120	36.3	100	64.1		
	125	39.6	120	65.1		
Benzoyl chloride	−0.5°	0	60°	33.0	80°	52.9
	−4	7.9	70	37.5	70	55.1
	−7.5	12.7	80	42.2	60	57.2
	0	14.1	90	47.1	40	61.0
	20	18.8	93	48.7		
	40	25.0	90	50.6		

(Menschutkin, Ann. Inst. Pol. P.-le-Gr., **13.** 1.)

$+6H_2O$. Very deliquescent; very sol. i H_2O. Sol. in 0.25 pt. H_2O. (Thomson.)

Sol. in 2 pts. abs. alcohol at ordinary temp. and 1.5 pts. at b.-pt. (Thomson.)

Completely insol. in a solution of ether i H_2O sat. with HCl. (Havens, Am. J. Sci 1898, (4) **6.** 46.

Aluminum ammonium chloride, $AlCl_3, NH_4C$

(Baud, A. ch. 1904, (8) **1.** 46.)

Aluminum antimony chloride.

See **Chlorantimonate, aluminum.**

Aluminum barium chloride, $2AlCl_3, BaCl_2$.

(Baud, C. R. 1901, **133.** 869.)

Aluminum calcium chloride, basic.

$3CaO, CaCl_2, Al_2O_3+10H_2O$. (Steinmet Z. phys. Ch. 1905, **52.** 466.)

$10CaO, CaCl_2, 6Al_2O_3$. Slowly decomp. b boiling H_2O. (Gorgeu, Bull. Soc. 1887, (2 **48.** 51.)

Aluminum calcium chloride, $4AlCl_3, 3CaCl_2$

(Baud, A. ch. 1904, (8) **1.** 51.)

Aluminum nitrosyl chloride, $AlCl_3$, NOCl.

Deliquescent, and decomp. by H_2O. (Web Pogg, **118.** 471.)

Aluminum palladium chloride, $AlCl_3, PdCl_2$-$10H_2O$.

See **Chloropalladite, aluminum.**

Aluminum phosphorus ***penta*****chloride,** AlCl PCl_5.

Decomp. violently by H_2O. (Baudrimont

Aluminum phosphoryl chloride, $AlCl_3$, POC

Deliquescent. Sol. in H_2O with decom Sol. in warm $POCl_3$, from which it separat on cooling. (Casselmann, A. **98.** 220.)

Aluminum platinum chloride, $AlCl_3, PtCl_2$-$15H_2O$.

See **Chloroplatinite, aluminum.**

Aluminum potassium chloride, $AlCl_3$, KCl.

Slowly deliquescent. Sol. in H_2O wi evolution of heat and decomp. (Degen, **18.** 332.)

Aluminum selenium chloride, $2AlCl_3, SeCl_4$

Sol. in H_2O with evolution of heat a separation of traces of selenium. (Web Pogg. **104.** 427.)

Aluminum sodium chloride, $AlCl_3$, NaCl.

Much less deliquescent than $AlCl_3$. Sol. H_2O with evolution of heat. Upon evapora ing, NaCl crystallises out. (Wöhler.)

Aluminum strontium chloride, $4AlCl_3$, 3SrC

(Baud, A. ch. 1909, (8) **1.** 52.)

Aluminum sulphur chloride, $2AlCl_3, SCl_4$.

Decomp. by H_2O with evolution of mu

heat and separation of some sulphur. (Weber, Pogg. **104.** 421.)

$AlCl_3, SCl_4$. Decomp. by H_2O. (Ruff, B. 1901, **34.** 1757.)

Aluminum tellurium chloride, $2AlCl_3, TeCl_4$.

Very sol. in dil. H_2SO_4+Aq. (Weber, J. pr. **76.** 313.)

Aluminum chloride ammonia, $AlCl_3, NH_3$.

Sol. in H_2O. (Rose, Pogg, **24.** 248.)

Completely sol. in H_2O. (Baud, C. R. 1901, **132.** 135.)

$AlCl_3, 2NH_3$. Very hygroscopic. (Stillman, Am. Ch. J. 1895, **17.** 750.)

$AlCl_3, 3NH_3$. Decomp. by H_2O.

$AlCl_3, 5NH_3$. M. pt. 380°. (Baud, C. R. 1901, **132.** 135.)

$AlCl_3, 6NH_3$. Decomp. by H_2O. (Stillman, Am. Ch J. 1895, **17.** 752.) Somewhat hygroscopic. (Baud, C. R. 1901, **132.** 135.)

Aluminum chloride nitric oxide, $2AlCl_3$, NO.

Very hygroscopic. Decomp. rapidly in the air. Sol. in KOH+Aq. (Thomas, C. R. 1895, **121.** 130.)

Aluminum chloride phosphine, $3AlCl_3, PH_3$.

Decomp. by H_2O or NH_4OH+Aq. (Rose Pogg, **24.** 295.)

Aluminum chloride hydrogen sulphide.

Deliquescent. Decomp. by H_2O or NH_4OH +Aq. (Wöhler.)

Aluminum chloride sulphur *di*oxide, $AlCl_3, SO_2$.

Decomp. by H_2O, alcohol, or benzene. (Adrianowski, B. **12.** 688.)

$2AlCl_3, SO_2$. (Baud, A. ch. 1904, (8) **1.** 32.)

Aluminum cobalt, Co_3Al_3.

Sol. in strong acids. (Brunck, B. 1901, **34.** 2734.)

Aluminum copper, Cu_4Al_9.

Sol. in aqua regia; decomp. by HCl. (Brunck, B. 1901, **34.** 2733.)

Aluminum fluoride, AlF_3.

Anhydrous. Not attacked by H_2O or acids, and only very slightly by boiling conc. H_2SO_4. Insol. in boiling KOH+Aq. (Deville, C. R. **42.** 49.)

Insol. in ethyl acetate. (Naumann, B. 1910, **43.** 314.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4328.)

$+\frac{1}{2}H_2O$. Insol. in H_2O. Sl. sol. in HF. (Baud, C. R. 1902, **135.** 1104.)

$+H_2O$. Completely but only sparingly sol. in H_2O. (Mazzuchelli, Real. Ac. Linc. 1907, (5) **16,** I. 775; Chem. Soc. 1907, **92,** (2). 549.)

$+3\frac{1}{2}H_2O$. Two modifications: (1) Easily sol. in H_2O. Sol. in HF. (2) Insol. in H_2O. Sl. sol. in HF. (Baud, C. R. 1902, **135.** 1104.)

$+7H_2O$. Sol. in H_2O. (Deville, A. ch. (3) **61.** 329.)

Min. *Fluellite.*

$+8\frac{1}{2}H_2O$. Very efflorescent. Sat. solution contains 3.85 g. AlF_3 per 100 g. at 11° and 1.2 g. at −0.2°. (Mazzucchelli, Real. Ac. Linc. 1907, (5) **16,** I. 775; Chem. Soc. 1907, (2), **92.** 549.)

Aluminum hydrogen fluoride, $3AlF_3, 2HF+5H_2O$.

Sol. in H_2O; precipitated by alcohol. (Deville.)

$2AlF_3, HF+5H_2O$. (Deville, A. ch. (6) **61.** 329.)

Aluminum ammonium fluoride, AlF_3, NH_4F.

Somewhat sol. in H_2O; insol. in H_2O containing NH_4OH or NH_4F. (Berzelius, Pogg. **1.** 45.)

$AlF_3, 2NH_4F+1.5H_2O$. Sol. in 100 pts. H_2O at 16°. (Baud, C. R. 1902, **135.** 1338.)

$AlF_3, 3NH_4F$. Nearly insol. in H_2O; easily sol. in dil. acids. (Petersen, J. pr. (2) **40.** 35.)

Quite easily sol. in H_2O, but insol. in NH_4F+Aq. (Helmholt, Z. anorg. **3.** 129.)

Aluminum barium fluoride.

Apparently not obtained in pure state. (Röder.)

Aluminum calcium fluoride, AlF_3, CaF_2+H_2O.

Min. *Evigtokite.*

Aluminum calcium sodium fluoride, $AlF_3, CaF_2, NaF+H_2O$.

Min. *Pachnolite.*

Aluminum cobaltous fluoride, AlF_3, CoF_2+7H_2O.

Sol. in dil. HF+Aq. (Weinland, Z. anorg. 1899, **22.** 272.)

Aluminum cupric fluoride, $2AlF_3, CuF_2$.

Very slowly but completely sol. in H_2O. (Berzelius.)

$AlF_3, 2CuF_2+11H_2O$. Sol. in dil. HF+Aq. (Weinland, Z. anorg. 1899, **22.** 272–76.)

$2AlF_3, 3CuF_2+18H_2O$. Sol. in dil. HF+Aq. (Weinland.)

Aluminum cupric hydrogen fluoride, $AlF_3, CuF_2, HF+8H_2O$.

Efflorescent in the air. Sol. in dil. HF+Aq. (Weinland, Z. anorg. 1899, **22.** 272.)

Aluminum iron (ferrous) fluoride, AlF_3, FeF_2+7H_2O.

Sl. sol. in dil. HF+Aq. (Weinland, Z. anorg. 1899, **22.** 270.)

Aluminum lithium fluoride.

Insol. in H_2O. (Berzelius.)

Aluminum magnesium fluoride.

$2AlF_3, MgF_2$ (?). (Röder.)

Aluminum nickel fluoride, AlF_3, NiF_2+7H_2O.

Sl. sol. in dil. HF+Aq. (Weinland, Z. anorg. 1899, **22.** 271.)

Aluminum potassium fluoride, AlF_3, 3KF.

Very sl. sol. in acid solutions, and still less in H_2O. (Gay-Lussac and Thénard.)

AlF_3, 2KF. As above.

Aluminum silicon fluoride.

See **Fluosilicate, aluminum.**

Aluminum sodium fluoride.

$2AlF_3$, 3NaF. Min. *Chiolite.*

AlF_3, 2NaF. Min. *Chodneffite.*

AlF_3, 3NaF. Min. *Cryolite.* Sl. sol. in H_2O. Insol. in HCl+Aq. Decomp. by H_2SO_4, or by boiling with NaOH+Aq.

Aluminum strontium fluoride.

As the Ba salt. (Röder.)

Aluminum thallous fluoride, $2AlF_3$, 3TlF.

Ppt. Sl. sol. in H_2O. (Ephraim, Z. anorg. 1909, **61.** 243.)

Aluminum zinc fluoride, AlF_3, ZnF_2+7H_2O.

Sol. in dil. HF+Aq. (Weinland, Z. anorg. 1899, **22.** 272.)

$2AlF_3$, ZnF_2. Slowly but completely sol. in H_2O. (Berzelius.)

Aluminum hydroxide, Al_2O_3, H_2O $=Al_2O_2(OH)_2$.

Dehydrated by conc. acids, without dissolving. (Becquerel, C. R., **67.** 108.)

Min. *Diaspore.* Insol. in HCl+Aq, and not attacked by boiling conc. H_2SO_4, unless it has been ignited.

Al_2O_3, $2H_2O=Al_2O(OH)_4$. Pptd. Al hydroxide, when boiled twenty hours with H_2O is insol. in acids and alkalies, and has the above composition. (St. Gilles, A. ch. (3) **46.** 57.)

Min. *Bauxite.*

Soluble modifications—(a) *Meta-aluminum hydroxide From basic Al acetate.* Sol. in H_2O and more readily in $HC_2H_3O_2$. The aqueous solution is coagulated by traces of alkalies, many acids, and salts, while other acids and salts have no effect. Thus, 1 pt. H_2SO_4 in 1000 pts. H_2O, added to 7000 pts. of above solution containing 20 pts. Al_2O_3, converts the liquid into a nearly solid mass. Citric, tartaric, oxalic, chromic, molybdic, racemic, suberic, salicylic, benzoic, gallic, lactic, cinnamic, butyric, valeric, camphoric, picric, uric, meconic, comenic, and hemipinic acids act in the same way. HCl and HNO_3 have far less action, 600 mols. being necessary to produce the same effect as 1 mol. H_2SO_4, while acetic, formic, boric, arsenious, pyromeconic, and opianic acids do not coagulate the solution, except when moderately conc. 1 pt. KOH in 1000 pts. H_2O coagulates 9000 pts. of the solution. NaOH, NH_4OH, and $Ca(OH)_2$ have the same effect.

The solution is not coagulated by acetates, unless added in large quantity, and even then the ppt. is redissolved when treated with H_2O. Nitrates and chlorides coagulate with difficulty; Na_2SO_4, $MgSO_4$, and $CaSO_4$+Aq, however, have as strong an action as a liquid containing the same amount of H_2SO_4. A teaspoonful of the solution introduced into the mouth solidifies at once from the action of the saliva. The ppt. formed by acids is not sol. in an ecessx of the acid, but by the long continued action of conc. H_2SO_4, especially if hot, the ppt. is dissolved; boiling conc. HCl+Aq also dissolves it, but less readily than H_2SO_4. The ppt. is sol. in boiling conc. KOH+Aq. The residue, when the solution is evaporated at 100°, has composition Al_2O_3, $2H_2O$, and is insol. in acids. (Crum, Chem. Soc. **6.** 225.)

(b) *By Dialysis.* Sol. in H_2O, from which it is separated by extremely small amounts of various substances, as acids, ammonia, salts (especially K_2SO_4), caramel, etc. An excess of acid dissolves the coagulum. If the solution contains 0.5% Al_2O_3 or less, it may be boiled without change, but the hydroxide separates out suddenly when it is reduced to ½ its vol., and even very dil. solutions gelatinise spontaneously in a few days. The solution is not coagulated by alcohol or sugar. (Graham, A. **121.** 41.)

Al_2O_3, $3H_2O=Al(OH)_3$. *Crystallised.* Difficultly sol. in acids and alkalies. (Cossa, N. Cim. (2) **3.** 228.) Insol. in boiling HCl+Aq. (Wöhler, A. **113.** 249.) Sl. sol. in KOH+Aq; nearly insol. in cold H_2SO_4, HCl, HNO_3+Aq; very slowly sol. in hot HCl+Aq, more readily in hot H_2SO_4. (v. Bonsdorff, Pogg. **27.** 275.)

α-modification. Unstable. Changes into β-modification. Sol. in N-H_2SO_4 at ord. temp. Sol. in N-NaOH and in hot NaOH of concentration $5Na_2O$, $100H_2O$. (Russ, Z. anorg. 1904, **41.** 226.)

β-modification. Insol. in N-H_2SO_4 at ord. temp. Difficulty sol. in warm N-NaOH, but easily sol. in hot NaOH of concentration $5Na_2O$, $100H_2O$. Its solubility in NaOH increases with increase in concentration of the hydroxyl ions. (Russ.)

δ-modification. Easily sol. in conc. H_2SO_4; only sl. sol. in HCl, HNO_3 or acetic acids, or in alkali+Aq. (Tommasi, C. C. **1905,** II. 605.)

Min. *Gibbsite.* Sol. in HCl+Aq, and dil. H_2SO_4+Aq. Readily sol. in conc. KOH, and NaOH+Aq.

Precipitated. Completely insol. in H_2O or H_2CO_3+Aq. Easily sol. in acids when freshly pptd., but solubility diminishes on standing.

Easily sol. in KOH or NaOH+Aq. (Sonnenschein.)

Herz (Z. anorg. **25.** 155) found that aluminum hydroxide which has been dried in a vacuum dessicator requires for solution in $NaOH+Aq$. 3 atoms Na to 1 atom Al. Slade (Z. Elektrochem. 1911, **17.** 261) was unable to obtain this result. Herz says Slade's error is due to insufficient shaking of the solution. (Herz, Z. Elektrochem. 1911, **17.** 403.)

New solubility determinations verify the statement of Herz (Z. anorg. 25, 155) that the solubility of $Al(OH)_3$ in $NaOH+Aq$ is proportional to the concentration of NaOH. They do not, however, verify his statement that the ratio Na : Al in the solutions is always 3 : 1, for the author finds that the ratio Na : Al varies from 2 : 1 to 10 : 1 depending on the conditions of precipitation and the method and duration of drying of the $Al(OH)_3$. (Slade, Z. Elektrochem, 1912, **18.** 1.)

Sl. sol. in NH_4OH+Aq when freshly pptd., but presence of NH_4 salts diminish its solubility, and it separates out completely after long standing. (Fresenius.)

Somewhat sol. in NH_4OH+Aq, the more readily the larger the vol. of H_2O. Somewhat sol. in $(NH_4)_2CO_3+Aq$, but less than in NH_4OH+Aq. Sl. sol. in dil. NH_4Cl+Aq, unless that salt be in large excess. It is finally wholly pptd. if allowed to stand several days.

18752 pts. NH_4OH+Aq (4 % NH_4OH) dissolve an amt. of $Al(OH)_3$ corresponding to one pt. Al_2O_3; NH_4Cl prevents this solubility almost completely. (Hanamann, Pharm. Viertelj. **12.** 527.)

$Al(OH)_3$, prepared by ppt. of a solution of $Al(NO_3)_3$ with NH_4OH, filtered and washed, is insol. in NH_4OH+Aq.

$Al(OH)_3$ prepared by pptn. of a solution of potassium aluminate with NH_4Cl, is sol. in a large excess of NH_4OH if this is added to the ppt. at once. This modification which is sol. in NH_4OH is unstable and easily goes over into the modification which is insol. in NH_4OH. (Renz, B. 1903, **36.** 2751.)

Conc. $(NH_4)_2CO_3+Aq$ does not dissolve $Al(OH)_3$, and not a trace is dissolved by boiling conc. NH_4Cl+Aq. (Weeren, Pogg. **92.** 97.)

With NH_4F+Aq, it forms a double salt, $AlF_3, 3NH_4F$, which is sol. in H_2O, but not in NH_4F+Aq. (Helmholt, Z. anorg. **3.** 127.)

Insol. in $(NH_4)_2S+Aq$. (Malaguti and Durocher, A. ch. (3) **17.** 421.) Fuchs found, on the contrary, that it is not wholly insol. in $(NH_4)_2S+Aq$. (Fresenius, Quant.)

Insol. in $FeCl_3+Aq$. (Béchamp.)

Determinations of the solubility of aluminum hydroxide in $AlCl_3+Aq$ show that part goes into solution to form a compound, while the greater part is in the colloidal form. (Fischer, Z. anorg. 1904, **40.** 46.)

Only sl. sol. in conc. $Al_2(SO_4)_3+Aq$, but solubility increases with decrease in concentration of $Al_2(SO_4)_3$ until it reaches a maximum at a concentration of 32 % $Al_2(SO_4)_3$ at 20°, 28 % at 40°, and 38 % at 60°. With further decrease in concentration of $Al_2(SO_4)_3$ the solubility of $Al(OH)_3$ in $Al_2(SO_4)_3$ diminishes. (Kremann, C. A. **1909.** 2422.)

Sol. in $Ba(OH)_2+Aq$. (Rose.)

Sol. in boiling $Fe(NO_3)_3$, $Cr(NO_3)_3$, $Bi(NO_3)_3$, $Hg(NO_3)_2$, $HgNO_3$, $SnCl_2$, and $SbCl_3+Aq$. (Persoz.)

Insol. in HCN or cold $KCN+Aq$; but sl. sol. in hot $KCN+Aq$. (Rose.)

Insol. in $KC_2H_3O_2+Aq$. (Osann, 1821.)

When moist, sol. in H_2SO_3+Aq, from which it is repptd. on boiling. (Berthier, A. ch. (3) **7.** 76.)

Somewhat sol. in $NaC_2H_3O_2+Aq$. (Mercer.)

Not pptd. by NH_4OH+Aq in presence of Na citrate. (Spiller.)

Sol. in ethyl amine, amyl amine, sinkaline, ethyl picoline hydroxide, stibethylium hydroxide, triethyltoluenyl ammonium hydroxide+Aq. (Friedländer.)

Sol. in alkyl amines. (Renz, B. 1903, **36.** 2751.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4328.)

Sol. to a considerable extent in $K_2C_4H_4O_6+Aq$.

Very sl. sol. in cane sugar+Aq. (Ramsey.)

Solubility in glycerine+Aq containing about 60 % by vol. of glycerine. 100 cc. of the solution contain 0.25 g. Al_2O_3. (Müller, Z. anorg. 1905, **43.** 322.)

$Al_2O_3, 5H_2O$. Insol. in H_2O, NH_4OH+Aq and alcohol. Sol. in HCl and HNO_3+Aq. (Zunino, Gazz. ch. it. 1900, **30** (1). 194.)

$Al_6O_{14}H_{10}$, "Trialuminum hydroxide."

Not sol. in conc. acids in the cold; not sol. in KOH (cold) and only sl. sol. in hot KOH. Characterized by its solubility in exactly one mol. dil. HCl. Dil. solutions do not gelatinize even on long standing. Conc. solution of NH_4Cl and other salts cause ppt. which redissolves on addition of H_2O.

Alkalies and alkali carbonates decomp. the salt with HCl and ppt. trialuminium hydroxide. H_2SO_4 and sol. sulphates give insol. compds. with the hydrate. HNO_3 like HCl gives soluble compds. with the hydrate. (Structural formula given.) (Schlumberger, Bull. Soc. 1895, (5) **13.** 41–65; C. C. **1895,** I. 421.)

Aluminum iodide, AlI_3.

Anhydrous. Fumes on air and deliquesces. Sol. in H_2O with evolution of much heat. Sol. in CS_2 and crystallizes from the hot sat. solution on cooling. (Weber.) Sol. in alcohol (Weber); ether and tetrachlormethane. (Gustavson.)

Sol. in $AlBr_3$. (Isbekow, Z. anorg. 1913, **84.** 26.)

$+6H_2O$. Very sol. in H_2O.

Aluminum mercuric iodide, AlI_3, HgI_2+8H_2O.

Very deliquescent; sol. in H_2O without decomp. (Duboin, C. R. 1908, **146.** 1028.)

Aluminum potassium iodide, AlI_3, KI.

Sol. in H_2O with evolution of much heat. (Weber, Pogg. **101.** 469.)

Aluminum iodide ammonia, AlI_3, $3NH_3$.

Decomp. by H_2O. (Weber, Pogg. **103.** 263.)

Aluminum iodide mercuric oxyiodide, $2AlI_3$, HgO, $3HgI_2+15H_2O$.

(Duboin, C. R. 1907, **145.** 714.)

Aluminum iron, $FeAl_3$.

Readily sol. in strong HNO_3. (Brunck, B. 1901, **34.** 2734.)

Aluminum manganese, Mn_2Al_7.

Sol. in strong HCl. (Brunck, B. 1901, **34.** 2735.)

Aluminum molybdenum, Al_4Mo.

Easily sol. in hot HNO_3 or HCl. (Wöhler, A. 1860, **115.** 103.)

Al_2Mo. (Guillet, C. R. 1901, **133.** 293.)

AlMo. (Guillet.)

$AlMo_4$. Not attacked by dil. HCl+Aq. (Guillet.)

$AlMo_{20}$. Not attacked by HCl+Aq. (Guillet.)

Aluminum nickel, Al_3Ni.

Sol. in strong acids. (Brunck, B. 1901, **34.** 2734.)

Aluminum nitride, Al_2N_2.

Slowly attacked by hot or cold H_2O. Decomp. by acids and aqueous solutions of the alkalies, especially when they are concentrated. (Mallet, A. **186.** 155.)

Easily decomp. H_2O when finely powdered. (Rossil, C. R. 1895, **121.** 942.)

Decomp. by moist air and by boiling H_2O and by alkalis+Aq. (Franck, Ch. Z. 1897, **21.** 263.

Aluminum oxide, Al_2O_3.

Crystalline. Min. *Corundum, sapphire, ruby, emery.* Insol. in acids.

Amorphous. Ignited Al_2O_3 is insol. in acids except that it dissolves slowly when heated with a mixture of 1 pt. H_2SO_4 and 1 pt. H_2O. (Berzelius.) Slowly sol. in boiling HCl+Aq. (Rose, Pogg. **52.** 595.)

Sol. in 22 pts. of a mixture of 8 pts. H_2SO_4 and 1 pt. H_2O. (Mitscherlich.) The lower the temperature at which Al_2O_3 has been heated, the more sol. is it in acids and alkalies.

Solubility in (calcium sucrate+sugar)+Aq.

1 l. solution containing 418.6 g. sugar and 34.3 g. CaO dissolves 1.35 g. Al_2O_3; 1 l. solution containing 296.5 g. sugar and 24.2 g. CaO dissolves 0.32 g. Al_2O_3; 1 l. solution containing 174.4 g. sugar and 14.1 g. CaO dissolves 0.19 g. Al_2O_3. (Bodenbender, J. B. **1865.** 600.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4328.)

See also **Aluminum hydroxide.**

Aluminum peroxide, Al_2O_3, $Al_2O_4+10H_2O$.

Ppt.; sol. in acids with decomp. (Terni, C. A. **1912.** 3068.)

Aluminum oxybromide.

Basic aluminum bromides containing three equivalents or less of Al_2O_3 to one of $AlBr_3$ are sol. in H_2O. Those containing more than three equivalents are insol. (Ordway, Am. J. Sci. (2) **26.** 203.)

Aluminum oxychloride.

Sol. in dil. acids or alkalies. Decomp. by H_2O. (Hautefeuille and Perrey, C. R. **100.** 1220.)

Basic aluminum chlorides containing two equivalents or less of Al_2O_3 to one of $AlCl_3$ are sol. in H_2O. Those containing more than two equivalents are insol. (Ordway.)

Al_2O_3, $3AlCl_3+3H_2O$. (Tommasi, Bull. Soc. (2) **37.** 443.)

Al_2O_3, $8AlCl_3+3H_2O$. (Tommasi.)

$3Al_2O_3$, $AlCl_3+15H_2O$. (Tommasi.)

Aluminum phosphide, Al_3P.

Unstable. (Franck, Ch. Z. 1898, **22.** 240.)

Al_2P_2. Decomp. by H_2O. (Fonzes-Diacon, C. R. 1900, **130.** 1315.)

Unstable. (Franck, Ch. Z. 1898, **22.** 240.)

Al_3P_7. Decomp. by H_2O and acids. (Franck.)

Al_3P_7. Decomp. by H_2O and acids. (Franck, Ch. Z. 1898, **22.** 288.)

Al_5P_3. Unstable. (Franck, Ch. Z. 1898, **22.** 240.)

Aluminum platinum, Pt_3Al_{10}.

The Al is dissolved out by HCl. (Brunck, B. 1901, **34.** 2735.)

Aluminum selenide, Al_2Se_3.

Decomp. by H_2O. (Fonzes-Diacon, C. R. 1900, **130.** 1315.)

Aluminum silicide, Al_2Si_4.

More easily sol. in acids than Al. (Winkler, J. pr. **91.** 193.)

Aluminum chromium silicide, $Al_2Cr_4Si_6$.

Insol. in hot conc. HCl, HNO_3, H_2SO_4 and aqua regia. Sol. in cold HF or in HF+HNO_3. Sol. in molten alkali. Insol. in NaOH+Aq, KOCl+Aq or fused $KClO_3$ or $KHSO_4$. (Manchot and Kieser, A. **1904,** 337, 356.)

$Al_2Cr_4Si_8$. Insol. in hot conc. HCl, HNO_3, H_2SO_4 and aqua regia. Sol. in HF and in molten alkali. (Manchot and Kieser, A. 1904, **337.** 358.)

Aluminum tungsten silicide.

Insol. in most acids and aqua regia. Easily sol. in HF, HNO_3 and in molten alkali. Not attacked by dil. NaOH+Aq. (Manchot and Kieser, A. 1904, **337.** 360.)

Aluminum vanadium silicide, $Al_2V_8Si_{13}$.

Sol. in HF. Not attacked by hot conc. HCl, HNO_3, H_2SO_4 or aqua regia. Decomp. by fusing with NaOH. Stable toward fused $KClO_3$. (Manchot, A. 1907, **357.** 134.)

Aluminum sulphide, AlS.

Decomp. by H_2O. Sol. in acids and alkalis. (Regelsberger, Z. Elektrochem, 1898, **4.** 548.)

Al_2S_3. Decomp. in moist air and by H_2O. (Wöhler.) Insol. in acetone. (Naumann, B. 1904, **37.** 4328.)

Aluminum chromium sulphide, Al_2S_3,CrS.

Sl. attacked by HCl+Aq. Gradually decomp. by HNO_3. (Houdard, C. R. 1907, **144.** 1115.)

Aluminum magnesium sulphide, Al_2S_3, MgS.

Decomp. by H_2O, alcohol and acids. (Houdard, C. R. 1907, **144.** 1116.)

Aluminum potassium sulphide.

Violently decomposed by H_2O. (St. Claire Deville, J. pr. **71.** 293.)

Does not exist. (Gratama, R. t. c. **3.** 4.)

Aluminum silver sulphide, $5Al_2S_3$, $4Ag_2S$.

(Cambi, Real. Ac. Linc. (5) **21,** II. 838.)

Aluminum telluride.

Decomp. by H_2O. (Wöhler, Pogg. **11.** 160.)

Aluminum titanide, Al_4Ti.

Not attacked by H_2O or by cold HNO_3. Sl. sol. in warm HNO_3. Sol. in cold conc. H_2SO_4 or HCl. Sol. in warm KOH+Aq. (Levy, A. ch. 1902, (6) **25.** 449.)

Sol. in HCl and in aqua regia. (Guillet.)

Al_3Ti. Sol. in hot dil. H_2SO_4 and in hot KOH+aq. Sol. in hot conc. acids. (Manchot, A. 1907, **357.** 142.)

Al_3Ti_2. Aluminothermic product is sol. in HCl and aqua regia. (Guillet.)

Aluminosulphuric acid, $Al_2(SO_4H)_6+7H_2O$.

Sol. in H_2O with decomp. into $Al_2(SO_4)_3$ and H_2SO_4. (Silberberger, M. 1904, **25.** 222.)

*Di*amide, N_2H_4.

See **Hydrazine.**

Amidochromic acid.

Amidochromates.

Do not exist. Those described by Darmstädter and Löwenthal are impure bichromates. (Wyrouboff, Bull. Soc. 1894, (3) **11.** 845–53; C. C. **1894,** II. 610.)

Ammonium amidochromate, $(NH_4)NH_2CrO_3$.

Very sol. in H_2O. (Löwenthal, Z. anorg. 1894, **6.** 363.)

Is ammonium dichromate. (Wyrouboff, Bull. Soc. (3) **11.** 845.)

Lithium amidochromate, $LiNH_2CrO_3$.

Very sol. in H_2O and acids. (Löwenthal, Z. anorg. 1894, **6.** 364.)

Potassium amidochromate, $KCrO_3NH_2$.

Sol. only in H_2O. Sat. solution in H_2O contains 13 % of the salt. (Heintze, J. pr. (2) **4.** 214.)

Amidophosphoric acid, $HPO_3(NH_2) = PO(NH_2)(OH)_2$.

Sol. in H_2O, but decomp. on standing or by heat. (Stokes, Am. Ch. J. **15.** 198.)

Aluminum amidophosphate.

Ppt. Sol. in NH_4OH+Aq. (Stokes.)

Ammonium amidophosphate, $NH_4HPO_3(NH_2)$.

Very sol. in H_2O. (Stokes.)

Barium amidophosphate, $BaPO_3(NH_2)+H_2O$.

Very sl. sol. in H_2O. (Stokes.)

$BaH_2(PO_3NH_2)_2+2\frac{1}{4}H_2O$. Quite difficultly sol. in H_2O. (Stokes.)

Calcium amidophosphate, $CaPO_3(NH_2)$.

Much less sol. in H_2O than Ba salt. (Stokes.)

$CaH_2(PO_3NH_2)_2$. Much less sol. in H_2O than the Ba salt. (Stokes.)

Chromic amidophosphate.

Ppt. Sol. in warm NH_4OH+Aq. (Stokes.)

Cobalt amidophosphate.

Neutral. Ppt.

Acid. Sl. sol. in H_2O; sol. in NH_4OH+Aq.

Cupric amidophosphate.

Neutral. Sl. sol. in H_2O.

Acid. Nearly insol. in H_2O.

Ferrous amidophosphate.

Neutral. Sol. in much H_2O, and in $HC_2H_3O_2$, or NH_4OH+Aq.

Acid. Nearly insol. in H_2O or NH_4Cl+Aq. Sol. in NH_4OH+Aq.

Ferric amidophosphate.

Neutral. Ppt. Sol. in excess of alkali

amidophosphate and in NH_4OH+Aq. Insol. in $HC_2H_3O_2$+Aq.
Acid. As the neutral salt.

Hydroxylamine amidophosphate, $(NH_3O)HPO_3(NH_2)$.
Sl. sol. in H_2O. (Stokes.)

Lithium amidophosphate, $LiHPO_3(NH_2)$.
Sl. sol. in H_2O. (Stokes.)

Magnesium amidophosphate, $MgPO_3(NH_2)+7H_2O$.
Very sl. sol. in H_2O; quite easily sol. in dil. NH_4Cl+Aq. Sol. in $HC_2H_3O_2$+Aq. (Stokes.)
$MgH_2(PO_3NH_2)_2 + 3\frac{1}{4}H_2O$. Insol. in NH_4Cl+Aq. (Stokes.)

Manganese amidophosphate.
Neutral. Ppt.
Acid. Sl. sol. in H_2O.

Nickel amidophosphate.
Neutral. Ppt. Sol. in $HC_2H_3O_2$ or NH_4OH+Aq.
Acid. Sl. sol. in H_2O.

Potassium amidophosphate, $K_2PO_3(NH_2)$.
Very sol. in H_2O and not decomp. by boiling. (Stokes.)
$KHPO_3(NH_2)$. Easily sol. in cold H_2O; insol. in alcohol. (Stokes.)

Silver amidophosphate, $Ag_2PO_3(NH_2)$.
Almost insol. in H_2O. Sol. in HNO_3 or NH_4OH+Aq.
$AgHPO_3(NH_2)$. Sl. sol. in H_2O; easily sol. in dil. HNO_3 or $HC_2H_3O_2$+Aq, also in NH_4OH+Aq.

Sodium amidophosphate, $Na_2PO_3(NH_2)$.
Not deliquescent; very sol. in H_2O; pptd. from aqueous solution by alcohol. (Stokes.)
$NaHPO_3(NH_2)+\frac{1}{4}(?)H_2O$. Nearly insol. in cold, and decomp. by hot H_2O. Insol. in alcohol.

Zinc amidophosphate.
Neutral. Perceptibly sol. in H_2O.
Acid. Sl. sol. in H_2O; sol. in NH_4OH or $HC_2H_3O_2$+Aq.

*Di*amidophosphoric acid, $PO(NH_2)_2OH$.

Sol. in cold H_2O; almost insol. in alcohol; stable in the air but decomp. when heated and by boiling in aq. solution. (Stokes, Am. Ch. J. 1894, **16.** 130.)

Barium *di*amidophosphate, $[PO(NH_2)_2O]_2Ba$.
Very sol. in H_2O; insol. in alcohol; aq. solution decomp. slowly. (Stokes, Am. Ch. J. 1894, **16.** 134.)

Magnesium *di*amidophosphate, $[PO(NH_2)_2O]_2Mg$.
Sol. in H_2O; insol. in alcohol. (Stokes.)

Potassium *di*amidophosphate, $PO(NH_2)_2OK$.
Sol. in H_2O; not deliquescent; insol. in alcohol. (Stokes.)

Silver *di*amidophosphate, $PO(NH_2)_2OAg$.
Very stable; insol. in H_2O. Very sol. in NH_4OH+Aq. (Stokes.)

Sodium *di*amidophosphate, $PO(NH_2)_2ONa$.
Sol. in H_2O; not deliquescent; insol. in alcohol. (Stokes.)

*Di*amido*tri*hydroxylphosphoric acid.

Silver *di*amido*tri*hydroxylphosphate, $(AgO)_3P(NHAg)_2$.
(Stokes, Am. Ch. J. 1894, **16.** 147.)
$(AgO)_3P(NH_2)(NHAg)$. Insol. in cold H_2O. (Stokes.)
$(AgO)_3P(NH_2)_2$. Decomp. by cold H_2O. (Stokes.)
$+2H_2O$. Decomp. by boiling H_2O. (Stokes.)

Amidoimidophosphoric acid.

Amido*hex*imido*hepta*phosphoric acid, $OH.PO.(NH_2)[NH.PO(OH)]_5.NH.PO(OH)_2 = P_7N_7O_{15}H_{16}$.
Known only in solution in H_2O. (Stokes, Am. Ch. J. 1898, **20.** 758.)

Silver *di*amido*pyr*imidophosphate, $NH(PO.NH_2.OAg)_2$.
Almost insol. in H_2O; sol. in NH_4OH+Aq. (Stokes, Am. Ch. J. 1894, **16.** 136.)

Silver amido*tetr*imido *penta*phosphate, $P_5N_5O_{11}H_3Ag_9$.
Ppt. (Stokes, Am. Ch. J. 1898, **20.** 752.)

Silver amido*hex*imido*hepta*phosphate, $P_7N_7O_{15}H_9Ag_7$.
Ppt.; decomp. by acetic acid. (Stokes, Am. Ch. J. 1898, **20.** 759.)

Sodium amido*di*imido*tri*phosphate, $PO.ONa<\begin{matrix}NH.PO(ONa)_2\\NHPO(ONa)NH_2\end{matrix}$.
$=P_3N_3O_7H_4Na_4+H_2O$.
Unstable; sol. in H_2O; insol. in alcohol. (Stokes, Am. Ch. J. 1896, **18.** 643.)

Sodium amido*hex*imido*hepta*phosphate, $P_7N_7O_{15}H_9Na_7$.
Sol. in H_2O; pptd. by alcohol. (Stokes, Am. Ch. J. 1898, **20.** 758.)

Amidophosphimic acid.

Silver amidophosphimate, $P(NH)NH_2(OAg)_2$.

Decomp. by heat; decomp. in contact with H_2O. (Stokes, Am. Ch. J. 1894, **16.** 139.)

$(AgO)_2P(NAg)(NHAg)$.(?) Sl. sol. in NH_4OH+Aq. (Stokes, Am. Ch. J. 1894, **16.** 149.)

Amidosulphonic acid, $HOSO_2NH_2$.

Easily sol. in H_2O, less easily in alcohol. (Berglund, B. **9.** 252 and 1896.)

Very stable; less easily sol. in H_2O than its K salt. (Raschig, A. **241.** 177.)

Stable in air. Non-deliquescent when cold. Sol. in 5 pts. H_2O at 0° and in 2½ pts. H_2O at 70°. Solution in H_2O can be boiled several minutes without decomp. Solubility is decreased by addition of H_2SO_4, so that if 1/5–1/4 pt. H_2SO_4 is added to H_2O, 100 pts. of the liquid dissolve only 3 pts. $HOSO_2NH_2$ in the cold. Pptd. from solution by HNO_3 or glacial acetic acid, but not by HCl. Solubility is decreased by presence of $NaHSO_4$. (Divers and Haga, Chem. Soc. 1896, **69.** 1641.)

Amidosulphonates.

Easily sol. in H_2O; sl. sol. in alcohol.

Aluminum amidosulphonate.

Very sol. in H_2O. (Berglund, Bull. Soc. (2) **29.** 422.)

Ammonium amidosulphonate, $(NH_4)NH_2SO_3$.

Deliquescent. Sol. in H_2O; insol. in alcohol.

Ammonium silver amidosulphonate, $NH_4SO_3(NH_2)$, $AgSO_3(NH_2)$.

(Ephraim & Gurewitsch, B. 1910, **43.** 148.)

Barium amidosulphonate, $Ba(NH_2SO_3)_2$.

Sol. in 3 pts. H_2O. (Berglund, l.c.)

Cadmium amidosulphonate, $Cd(NH_2SO_3)_2+5H_2O$.

Very sol. in H_2O. (B.)

Calcium amidosulphonate, $Ca(NH_2SO_3)_2+4H_2O$.

Very sol. in H_2O. (B.)

Cobalt amidosulphonate, $Co(NH_2SO_3)_2+3H_2O$.

Sol. in H_2O. (B.)

Copper amidosulphonate, $Cu(NH_2SO_3)_2+2H_2O$.

Sol. in H_2O. (B.)

Gold (auric) potassium amidosulphonate, $K_3Au_2(NSO_3)_3$.

Very sl. sol. in cold, more easily sol. in hot H_2O. Sol. in dil. HCl+Aq. (Hofmann, B. 1912, **45.** 1735.)

Lead amidosulphonate, $Pb(NH_2SO_3)_2+H_2O$.

The most sol. of all amidosulphonates. (B.)

Lithium amidosulphonate. $LiNH_2SO_3$.

Deliquescent. (B.)

Magnesium amidosulphonate.

Very sol. in H_2O.

Manganese amidosulphonate, $Mn(NH_2SO_3)_2+3H_2O$.

Very sol. in H_2O. (B.)

Mercuric amidosulphonate, basic, $Hg(HgOSO_3NH_2)_2$.

Insol. in 3.5 % HNO_3+Aq. Very sol. in 3 % HCl+Aq. (Hofmann, B. 1912, **45.** 1733.

$+2H_2O$. Insol. in hot H_2O. Sol. in KOH+Aq. (Divers and Haga, Chem. Soc. 1896, **69.** 1649.)

Mercuric potassium amidosulphonate, $KHgNSO_3$.

Very sl. sol. in cold H_2O and cold dil. KOH+Aq. Sol. in 3 % HCl+Aq. (Hofmann, B. 1912, **45.** 1732.)

Mercuric sodium amidosulphonate, $NaHgNSO_3$.

Nearly completely sol. in hot H_2O. (Hoffmann, B. 1912, **45.** 1734.)

Nickel amidosulphonate, $Ni(NH_2SO_3)_2+3H_2O$.

Sol. in H_2O. (B.)

Potassium amidosulphonate, KNH_2SO_3.

Sol. in H_2O. (Berglund.)

Potassium silver amidosulphonate, $NHAgSO_3K+H_2O$.

Decomp. by H_2O; sol. in NH_4OH+Aq. (Hoffmann, B. 1912, **45.** 1734.)

Silver amidosulphonate, $AgNH_2SO_3$.

Sol. in 15 pts. H_2O at 19° (B.)

Sodium amidosulphonate, $NaNH_2SO_3$.

Sol. in H_2O.

Strontium amidosulphonate, $Sr(NH_2SO_3)_2+4H_2O$.

Sol. in H_2O.

Thallium amidosulphonate, $TlNH_2SO_3$.

Sol. in H_2O.

Uranyl amidosulphonate.

Sol. in H_2O.

Zinc amidosulphonate, $Zn(NH_2SO_3)_2+4H_2O$

Sol. in H_2O.

Amidosulphurous acid.

Ammonium amidosulphite, $NH_2.SO_2.NH_4$.

Very deliquescent. Decomp. in the air with loss of NH_3. Sol. in H_2O with decomp. Sol. in anhydrous alcohol. Sl. sol. in dry. ether. (Divers, Chem. Soc. 1900, **77.** 330.)

Ammonia, NH_3.

Very sol. in H_2O, with evolution of much heat.

1 vol. H_2O absorbs 670 vols. (½ pt. by weight) NH_3 at +10° and 29.8 in. pressure; sp. gr. of solution =0.875. (Davy.)

At low temperatures H_2O absorbs more than ½ its weight of NH_3, and sp. gr. of solution = 0.850. (Dalton.)

100 pts. H_2O absorb 8.41 pts. NH_3 at 24°; 5.96 pts. at 55°. (Osann.)

1 vol. H_2O absorbs 780 vols. NH_3, 6 vols. H_2O increasing to 10 vols. sat. NH_4OH+Aq; 1 vol. sat. NH_4OH+Aq contains 468 vols. NH_3. (Thomson.)

1 vol. H_2O absorbs 450 vols. NH_3 at 15°. (Dumas.)

1 vol. H_2O absorbs 700 vols. NH_3 at ordinary temperature. (Otto.)

100 pts. H_2O absorb in NH_3 gas 47.7 pts. NH_3 by weight. (Berzelius.)

1 vol. H_2O absorbs 505 vols. NH_3 and vol. is increased to 1.5 vol., and sp. gr. becomes 0.900. (Ure.)

1 vol. H_2O at 0° and 760 mm. absorbs 1177.3 vols. NH_3. (Sims.)

1 vol. H_2O at 0° and 760 mm. absorbs 1146 vols. NH_3. (Roscoe and Dittmar.)

1 vol. H_2O at 0° and 760 mm. absorbs 1049.6 vols. NH_3. (Carius.)

1 vol. H_2O at 0° and 760 mm. absorbs 1270 vols. NH_3. (Berthelot.)

1 vol. H_2O at 0° and 760 mm. absorbs 1050 vols. NH_3. (Bunsen.)

100 cc. H_2O absorb 64.50 g. NH_3. (Raoult.)

Solubility of NH_3 in H_2O at 760 mm. and t°: 1 g. H_2O absorbs g. NH_3, according to Roscoe and Dittmar (A. **122.** 347) (RD); and according to Sims (A. **118.** 345) (S).

t°	g. NH_3 RD	g. NH_3 S	t°	g. NH_3 RD	g. NH_3 S
0	0.875	0.899	36	0.343	0 363
2	0.833	0.853	38	0.324	0.350
4	0.792	0 809	40	0 307	0.338
6	0.751	0.765	42	0.290	0 326
8	0.713	0.724	44	0.275	0.315
10	0.679	0.684	46	0.259	0.304
12	0.645	0.646	48	0.244	0.294
14	0.612	0.611	50	0.229	0.284
16	0.582	0.578	52	0.214	0.274
18	0.554	0.546	54	0.200	0.265
20	0.526	0.518	56	0.186	0.256
22	0.499	0.490	58	.....	0.247
24	0.474	0.467	60	.....	0.238
26	0.449	0.446	70	.....	0.194
28	0.426	0.426	80	.....	0.154
30	0.403	0.408	90	.....	0.114
32	0.382	0.393	98	.....	0.082
34	0.362	0.378	100	.....	0.074

Solubility of NH_3 by vol. in H_2O at 760 mm. and t°: 1 vol. H_2O at 760 mm. and t° dissolves V vols. NH_3 gas, vols. reduced to 0° and 760 mm.

t°	V	t°	V
0	1049.60	13	759.55
1	1020.78	14	743.11
2	993.26	15	727.22
3	966.98	16	711.82
4	941.88	17	696.85
5	917.90	18	682.26
6	894.99	19	667.99
7	873.09	20	653.99
8	852.14	21	640.19
9	831.98	22	626.54
10	812.76	23	612.98
11	794.32	24	599.46
12	776.60	25	585.94

(Carius, A. **99.** **144.**)

Solubility of NH_3 in H_2O at P mm. pressure and 0°: 1 pt. H_2O absorbs pts. NH_3 at P mm. pressure and 0°.

P	Pts. NH_3	P	Pts. NH_3
10	0.044	900	0.968
20	0.084	950	1.101
30	0.120	1000	1.037
40	0.149	1050	1.075
50	0.175	1100	1.117
75	0.228	1150	1.161
100	0.275	1200	1.208
125	0.315	1250	1.258
150	0.351	1300	1.310
175	0.382	1350	1.361
200	0.411	1400	1.415
250	0.465	1450	1.469
300	0.515	1500	1.526
350	0.561	1550	1.584
400	0.607	1600	1.645
450	0.646	1650	1.707
500	0.690	1700	1.770
550	0.731	1750	1.835
600	0.768	1800	1.906
650	0.804	1850	1.976
700	0.840	1900	2.046
750	0.872	1950	2.120
800	0.906	2000	2.195
850	0.937	....	.....

(Roscoe and Dittmar, A. **112.** 349.)

In proportion as the temperature is higher, so much the more nearly does the solubility of NH_3 in H_2O conform to the law of Henry and Dalton, but only obeys it completely when the temperature is 100°, as is seen in the following table.

Solubility of NH_3 in H_2O at various pressures and temperatures: P = partial pressure, i. e. total pressure minus the tension of aqueous vapour at the given temperature; G = grams NH_3 dissolved in 1 g. H_2O at the given pressure; G at 760 = grams NH_3 that would be contained in 1 g. H_2O if the solubility was proportional to the pressure.

P	0°		20°		40°		100°	
	G at P	G at 760	G at P	G at 760	G at P	G at 760	G at P	G at 760
20	0.082	3.113	.....	.....	.....	.....	.....	.....
30	0.117	2.960	.....	....	....	....	....	....
40	0.148	2.820	.....	.....	.....	.....	.....	.....
60	0.169	2.522	0.119	1.513	.....	.....	.....	.....
80	0.240	2.280	0.141	1.337	0.052	0.497	.....	.....
100	0.280	2.127	0.158	1.200	0.064	0.490	.....	.....
120	0.316	2.000	0.173	1.095	0.076	0.483	.....	.....
140	0.346	1.880	0.187	1.017	0.088	0.476	.....	.....
160	0.375	1.780	0.202	0.962	0.099	0.470	.....	.....
180	0.398	1.684	0.207	0.918	0.109	0.462	.....	.....
200	0.421	1.598	0.232	0.881	0.120	0.454	.....	.....
250	0.472	1.434	0.266	0.810	0.145	0.440	.....	.....
300	0.519	1.315	0.296	0.750	0.168	0.426	.....	.....
350	0.563	1.223	0.325	0.705	0.191	0.414	.....	.....
400	0.606	1.152	0.353	0.670	0.211	0.402	.....	.....
450	0.650	1.100	0.378	0.638	0.232	0.399	.....	.....
500	0.692	1.052	0.403	0.612	0.251	0.382	.....	.....
550	0.732	1.012	0.425	0.587	0.269	0.372	.....	.....
600	0.770	0.975	0.447	0.566	0.287	0.363	.....	.....
650	0.809	0.946	0.470	0.550	0.304	0.355	.....	.....
700	0.850	0.923	0.492	0.534	0.320	0.347	0.068	0.074
750	0.891	0.903	0.514	0.521	0.335	0.339	0.073	0.074
760	0.899	0.899	0.518	0.518	0.338	0.338	0.074	0.074
800	0.937	0.888	0.535	0.504	0.349	0.332	0.078	0.074
850	0.980	0.876	0.556	0.497	0.363	0.325	0.083	0.074
900	1.029	0.869	0.574	0.485	0.378	0.319	0.088	0.074
950	1.077	0.862	0.594	0.475	0.391	0.313	0.092	0.073
1000	1.126	0.855	0.613	0.466	0.404	0.307	0.096	0.073
1050	1.177	0.852	0.632	0.457	0.414	0.300	0.101	0.073
1100	1.230	0.850	0.651	0.450	0.425	0.294	0.106	0.073
1150	1.283	0.848	0.669	0.442	0.434	0.287	0.110	0.073
1200	1.336	0.846	0.685	0.433	0.445	0.282	0.115	0.073
1250	1.338	0.844	0.704	0.428	0.454	0.276	0.120	0.073
1300	1.442	0.843	0.722	0.422	0.463	0.271	0.125	0.073
1350	1.496	0.842	0.741	0.417	0.472	0.266	0.130	0.073
1400	1.549	0.841	0.761	0.413	0.479	0.260	0.135	0.073
1450	1.603	0.840	0.780	0.409	0.486	0.255	.....	.....
1500	1.656	0.839	0.801	0.406	0.493	0.250	.....	.....
1600	1.758	0.835	0.842	0.400	0.511	0.242	.....	.....
1700	1.861	0.832	0.881	0.394	0.530	0.237	.....	.....
1800	1.966	0.830	0.919	0.388	0.547	0.231	.....	.....
1900	2.070	0.828	0.955	0.382	0.565	0.226	.....	....
2000	....	....	0 992	0 377	0 579	0.220	.....	.....
2100	.....	.....	.....	.....	0.594	0.215	.....	.....

(Sims, A. **118.** 346.)

Solubility of NH_3 in H_2O at temps. below 0°. One gram H_2O dissolves

grams NH_3	Temp.
0.947	—3.9°
1.115	—10°
1.768	—20°
2.781	—30°
2.946	—40°

(Mallet, Am. Ch. J. 1897, **19.** 807.

The solubility of NH_3 in H_2O does not follow Dalton's law at ord. temp., but does at temp. near 100°. (Konowaloff, J. Russ. Phys. Chem. Soc. 1894, **26.** 48; Chem. Soc. 1896, **70** (2). 351.

Sp. gr. of NH_4OH+Aq.

%NH_3	Sp. gr.	%NH_3	Sp. gr.
32.3*	0.8750	14.53	0.9435
29.25	0.8857	13.46	0.9476
26	0.9000	12.40	0.9513
25.37*	0.9054	11.56	0.9545
22.07	0.9166	10.82	0.9573
19.54	0.9255	10.17	0.9597
17.52	0.9326	9.6	0.9616
15.88	0.9385	9.5*	0.9632

(H. Davy, Elements, **1.** 241.)

* By direct experiment. The other numbers were obtained by calculation, making no allowance for compensation.

Sp. gr. of NH_4OH+Aq at 16°, according to Otto in his Lehrbuch.

% NH_3	Sp. gr.	% NH_3	Sp. gr.
12.000	0.9517	8.500	0.9650
11.875	0.9521	8.375	0.9654
11.750	0.9526	8.250	0.9659
11.625	0.9531	8.125	0.9664
11.500	0.9536	8.000	0.9669
11.375	0.9540	7.875	0.9673
11.250	0.9545	7.750	0.9678
11.125	0.9550	7.625	0.9683
11.000	0.9555	7.500	0.9688
10.950	0.9556	7.375	0.9692
10.875	0.9559	7.250	0.9697
10.750	0.9564	7.125	0.9702
10.625	0.9569	7.000	0.9707
10.500	0.9574	6.875	0.9711
10.375	0.9578	6.750	0.9716
10.250	0.9583	6.625	0.9721
10.125	0.9588	6.500	0.9726
10.000	0.9593	6.375	0.9730
9.875	0.9597	6.250	0.9735
9.750	0.9602	6.125	0.9740
9.625	0.9607	6.000	0.9745
9.500	0.9612	5.875	0.9749
9.375	0.9616	5.750	0.9754
9.250	0.9621	5.625	0.9759
9.125	0.9626	5.500	0.9764
9.000	0.9631	5.375	0.9768
8.875	0.9636	5.250	0.9773
8.750	0.9641	5.125	0.9778
8.625	0.9645	5.000	0.9783

Sp. gr. of NH_4OH+Aq, according to Ure in Dict. of Arts.

% NH_3	Sp. gr.	%NH_3	Sp. gr.
27.940	0.8914	15.900	0.9363
27.633	0.8937	14.575	0.9410
27.038	0.8967	13.250	0.9455
26.751	0.8983	11.925	0.9510
26.500	0.9000	10.600	0.9564
25.175	0.9045	9.275	0.9614
23.850	0.9090	7.950	0.9662
22.525	0.9133	6.625	0.9716
21.200	0.9177	5.300	0.9768
19.875	0.9227	3.975	0.9828
18.550	0.9275	2.650	0.9887
17.225	0.9320	1.325	0.9945

Sp. gr., b.-pt., and vols. gas in NH_4OH+Aq.

% NH_3	Sp. gr.	B.-pt.	Vols. gas in 1 vol. liquid
35.3	0.85	—3.3°	494
32.6	0.86	+3.3°	456
29.9	0.87	10°	419
27.3	0.88	16.6°	382
24.7	0.89	23.3°	346
22.2	0.90	30°	311
19.8	0.91	36.6°	277
17.4	0.92	43.3°	244
15.1	0.93	50°	211
12.8	0.94	56.6°	180
10.5	0.95	63.3°	147
8.3	0 96	70°	116
6.2	0.97	78.3°	87
4.1	0.98	86.1°	57
2.0	0.99	91.1°	28

(Dalton, in New System, **2.** 422.)

Sp. gr. of NH_4OH+Aq sat. at t°.

t°	Sp. gr.	t°	Sp. gr.	t°	Sp. gr.
0	0.8535	9	0.8746	18	0.8903
1	0.8561	10	0.8766	19	0.8916
2	0.8587	11	0.8785	20	0.8928
3	0.8611	12	0.8804	21	0.8940
4	0.8635	13	0.8823	22	0.8952
5	0.8658	14	0.8841	23	0.8963
6	0.8681	15	0.8858	24	0.8974
7	0.8703	16	0.8874	25	0.8984
8	0.8725	17	0.8889	..	......

(Carius, A. **99.** 141.)

Sp. gr. of NH_4OH+Aq at 14°, according to Carius (A. **99.** 148).

% NH_3	Sp. gr.	% NH_3	Sp. gr.
36.0	0.8844	35.2	0.8860
35.8	0.8848	35.0	0.8864
35.6	0.8852	34.8	0.8868
35.4	0.8856	34.6	0.8872

Sp. gr. of NH_4OH+Aq at 14°, etc.—*Cont.*

% NH_3	Sp. gr.	% NH_3	Sp. gr.
34.4	0.8877	22.2	0.9185
34.2	0.8881	22.0	0.9191
34.0	0.8885	21.8	0.9197
33.8	0.8889	21.6	0.9203
33.6	0.8894	21.4	0.9209
33.4	0.8898	21.2	0.9215
33.2	0.8903	21.0	0.9221
33.0	0.8907	20.8	0.9227
32.8	0.8911	20.6	0.9233
32.6	0.8916	20.4	0.9239
32.4	0.8920	20.2	0.9245
32.2	0.8925	20.0	0.9251
32.0	0.8929	19.8	0.9257
31.8	0.8934	19.6	0.9264
31.6	0.8938	19.4	0.9271
31.4	0.8944	19.2	0.9277
31.2	0.8948	19.0	0.9283
31.0	0.8953	18.8	0.9289
30.8	0.8957	18.6	0.9296
30.6	0.8962	18.4	0.9302
30.4	0.8967	18.2	0.9308
30.2	0.8971	18.0	0.9314
30.0	0.8976	17.8	0.9321
29.8	0.8981	17.6	0.9327
29.6	0.8986	17.4	0.9333
29.4	0.8991	17.2	0.9340
29.2	0.8996	17.0	0.9347
29.0	0.9001	16.8	0.9353
28.8	0.9006	16.6	0.9360
28.6	0.9011	16.4	0.9366
28.4	0.9016	16.2	0.9373
28.2	0.9021	16.0	0.9380
28.0	0.9026	15.8	0.9386
27.8	0.9031	15.6	0.9393
27.6	0.9036	15.4	0.9400
27.4	0.9041	15.2	0.9407
27.2	0.9047	15.0	0.9414
27.0	0.9051	14.8	0.9420
26.8	0.9057	14.6	0.9427
26.6	0.9063	14.4	0.9434
26.4	0.9068	14.2	0.9441
26.2	0.9073	14.0	0.9449
26.0	0.9078	13.8	0.9456
25.8	0.9083	13.6	0.9463
25.6	0.9089	13.4	0.9470
25.4	0.9094	13.2	0.9477
25.2	0.9100	13.0	0.9484
25.0	0.9106	12.8	0.9491
24.8	0.9111	12.6	0.9498
24.6	0.9116	12.4	0.9505
24.4	0.9122	12.2	0.9512
24.2	0.9127	12.0	0.9520
24.0	0.9133	11.8	0.9527
23.8	0.9139	11.6	0.9534
23.6	0.9145	11.4	0.9542
23.4	0.9150	11.2	0.9549
23.2	0.9156	11.0	0.9556
23.0	0.9162	10.8	0.9563
22.8	0.9168	10.6	0.9571
22.6	0.9174	10.4	0.9578
22.4	0.9180	10.2	0.9586

Sp. gr. of NH_4OH+Aq at 14°, etc.—*Cont.*

% NH_3	Sp. gr.	% NH_3	Sp. gr.
10.0	0.9593	5.0	0.9790
9.8	0.9601	4.8	0.9799
9.6	0.9608	4.6	0.9807
9.4	0.9616	4.4	0.9815
9.2	0.9623	4.2	0.9823
9.0	0.9631	4.0	0.9831
8.8	0.9639	3.8	0.9839
8.6	0.9647	3.6	0.9847
8.4	0.9654	3.4	0.9855
8.2	0.9662	3.2	0.9863
8.0	0.9670	3.0	0.9873
7.8	0.9677	2.8	0.9882
7.6	0.9685	2.6	0.9890
7.4	0.9693	2.4	0.9899
7.2	0.9701	2.2	0.9907
7.0	0.9709	2.0	0.9915
6.8	0.9717	1.8	0.9924
6.6	0.9725	1.6	0.9932
6.4	0.9733	1.4	0.9941
6.2	0.9741	1.2	0.9950
6.0	0.9749	1.0	0.9959
5.8	0.9757	0.8	0.9967
5.6	0.9765	0.6	0.9975
5.4	0.9773	0.4	0.9983
5.2	0.9781	0.2	0.9991

Hager also gives a table in his Commentar zur Pharmacopoea, which is practically identical with those here given.

Strength of NH_4OH+Aq of certain sp. gr. at 12°.

Sp. gr.	1 kg. solution contains g. NH_3	1 l. solution contains g. NH_3	1 litre consists of	
			H_2O in cc.	liquid NH_3 in cc.
0.870	384.4	334.5	535.5	464.5
0.880	347.2	305.5	574.5	425.5
0.890	311.6	277.3	612.7	387.3
0.900	277.3	249.5	650.5	349.5
0.910	244.9	222.8	687.2	312.8
0.920	213.4	196.3	723.7	276.3
0.930	182.9	170.1	759.9	240.1
0.940	152.9	143.7	796.3	203.7
0.950	124.2	118.0	832.0	168.0
0 960	97.0	93.1	866.9	133.1
0.970	70.2	68.0	902.0	98.0
0.980	45.3	44.3	935.7	64.3
0.990	21.0	20.7	969.3	30.7

(Wachsmuth, Arch. Pharm. (3) **8.** 510.)

Sp. gr. of NH_4OH+Aq at 15°.
(Most careful experiments.)

Sp. gr.	% NH_3	Sp. gr.	% NH_3
0.990	2.15	0.926	19.50
0.974	6.10	0.916	22.50
0.950	12.54	0.910	24.40

Sp. gr. of NH_4OH+Aq at 15°—*Continued*

Sp. gr.	% NH_3	Sp. gr.	% NH_3
0.900	27.70	0.882	34.8
0.890	31.40	0.880	35.5
0.885	33.5	.....	.....

(Grüneberg, Chem. Ind. **12.** 97.)

The following table is calculated from the above by interpolation:—

Sp. gr.	% NH_3	Sp. gr.	% NH_3
0.995	1 05	0.935	16.90
0.990	2.15	0.930	18.35
0.985	3.30	0.925	19.80
0.980	4.50	0.920	21.30
0.975	5.75	0 915	22 85
0.970	7.05	0.910	24.40
0.965	8.40	0.905	26.00
0.960	9.80	0.900	27.70
0.955	11 20	0.895	29.50
0.950	12.60	0.890	31.40
0.945	14.00	0.885	33.40
0.940	15.45	0.880	35.50

(Grüneberg.)

Sp. gr. of NH_4OH+Aq at 14°.

% HN_3	Sp. gr.	% NH_3	Sp. gr.
31	0.8933	15.6	0.9400
23.8	0.9116	11.7	0.9536
20.4	0.9246	5.1	0.9780

(Lunge and Smith, B. **17.** 777.)

Sp. gr. of NH_4OH+Aq at 15°, according to Lunge and Wiernik (Zeit. f. angew. Ch. **1889.** 183).
(Most carefully worked out and calculated.)

Sp. gr.	% NH_3	1 l. contains g. NH_3	Correction for ± 1°
1.000	0.00	0.0	0.00018
0.998	0.45	4.5	0.00018
0.996	0.91	9.1	0.00019
0.994	1.37	13.6	0.00019
0.992	1.84	18.2	0.00020
0.990	2.31	22.9	0.00020
0.988	2.80	27.7	0.00021
0.986	3.30	32.5	0.00021
0.984	3.80	37.4	0.00022
0.982	4.30	42.2	0.00022
0.980	4.80	47.0	0.00023
0.978	5.30	51.8	0.00023
0.976	5.80	56.6	0.00024
0.974	6.30	61.4	0.00024
0.972	6.80	66.1	0.00025
0.970	7.31	70.9	0.00025
0.968	7.82	75.7	0.00026

Sp. gr. of NH_4OH+Aq at 15°, etc.—*Continued*

Sp. gr.	% NH_3	1 l. contains g. NH_3	Correction for ± 1°
0.966	8.33	80.5	0.00026
0.964	8.84	85.2	0.00027
0.962	9.35	89.9	0.00028
0.960	9.91	95.1	0.00029
0.958	10.47	100.3	0.00030
0.956	11.03	105.4	0.00031
0.954	11.60	110.7	0.00032
0.952	12.17	115.9	0.00033
0.950	12.74	121.0	0.00034
0.948	13.31	126.2	0.00035
0.946	13.88	131.3	0.00036
0.944	14.46	136.5	0.00037
0.942	15.04	141.7	0.00038
0.940	15.63	146.9	0.00039
0.938	16.22	152.1	0.00040
0.936	16.82	157.4	0.00041
0.934	17.42	162.7	0.00041
0.932	18.03	168.1	0.00042
0.930	18.64	173.4	0.00042
0.928	19.25	178.6	0.00043
0.926	19.87	184.2	0.00044
0.924	20.49	189.3	0.00045
0.922	21.12	194.7	0.00046
0.920	21.75	200.1	0.00047
0.918	22.39	205.6	0.00048
0.916	23.03	210.9	0.00049
0.914	23.68	216.3	0.00050
0.912	24.33	221.9	0.00051
0.910	24.99	227.4	0.00052
0.908	25.65	232.9	0.00053
0.906	26.31	238.3	0.00054
0.904	26.98	243.9	0.00055
0.902	27.65	249.4	0.00056
0.900	28.33	255.0	0.00057
0.898	29.01	260.5	0.00058
0.896	29.69	266.0	0.00059
0.894	30.37	271.5	0.00060
0.892	31.05	277.0	0.00060
0.890	31.75	282.6	0.00061
0.888	32.50	288.6	0.00062
0.886	33.25	294.6	0.00063
0.884	34.10	301.4	0.00064
0.882	34.95	308.3	0.00065

NH_3 is much less sol. in KOH, or NaOH+Aq than in H_2O.

Solubility of NH_3 in H_2O, and KOH+Aq of various strengths: 100 pts. solvent absorbs g. NH_3 at t°.

t°	H_2O	KOH+Aq 11.25% K_2O	KOH+Aq 25.25% K_2O
0	90.00	72.00	49.50
8	72.75	57.00	37.50
16	59.75	46.00	28.50
24	49.50	37.25	21.75

(Raoult, A. ch. (5) **1.** 262.)

100 pts. sat. KOH+Aq dissolve only 1 pt. NH_3.

Solubility in NaOH+Aq is the same as in KOH+Aq of the same strength.

NH_4Cl+Aq absorbs slightly less NH_3 than the same vol. H_2O. $NaNO_3$, and NH_4NO_3+Aq absorb almost the same amount NH_3 as the same vol. H_2O. (Raoult, *l.c.*)

Solubility of NH_3 in 100 pts. $Ca(NO_3)_2$+Aq.

t°	H_2O	$Ca(NO_3)_2$+Aq 28.38% $Ca(NO_3)_2$	$Ca(NO_3)_2$+Aq 59.03% $Ca(NO_3)_2$
0	90.00	96.25	104.50
8	72.75	78.50	84.75
16	59.75	65.00	70.50

(Raoult, *l.c.*)

Solubility in salt solutions at 25°C.

Salt	Mols. NH_3 soluble in 1 liter of		
	.5-normal solution	1-normal solution	1.5-normal solution
KCl	0.930	0.866	0.809
KBr	0.950	0.904	0.857
KI	0.970	0.942	0.900
KOH	0.852	0.716	0.607
NaCl	0.938	0.889	0.843
NaBr	0.965	0.916	0.890
NaI	0.995	0.992	0.985
NaOH	0.876	0.789	0.716
LiCl	0.980	1.008	1.045
LiBr	1.001	1.040	1.090
LiI	1.030	1.094	1.190
LiOH	0.865	0.808	0.768
KF	0.839	0.722	0.626
KNO_3	0.923	0.862	0.804
KNO_2	0.920	0.855	0.798
KCN	0.926	0.858	0.802
KCNS	0.932	0.868	0.814
½K_2SO_4	0.875	0.772	0.678
½K_2SO_3	0.865	0.768	0.675
½K_2CO_3	0.788	0.650	0.554
½$K_2C_2O_4$	0.866	0.771	0.675
½K_2CrO_4	0.866	0.771	0.675
CH_3COOK	0.866	0.765	0.685
HCOOK	0.868	0.760	0.678
KBO_2	0.814	0.677	0.560
½K_2HPO_4	0.860	0.749	0.664
½Na_2S	0.887	0.795	0.726
$KClO_3$ 0.25-norm.	0.927	.....	.....
$KBrO_3$ 0.25-norm.	0.940	.....	.....
KIO_3 0.25-norm.	0.951	.....	.....

(Abegg & Riesenfeld, Z. phys. Ch. 1902, **40.** 100.)

Solubility in salts+Aq at 35° C.

Salt	Concentration of the aq. solution	Mols. NH_3 soluble in 1 liter of solution
KCl	0.5 normal	0.923
NaCl	"	0.966
CH_3COOK	"	0.902
½$(COOK)_2$	"	0.902
KOH	"	0.870
NaOH	"	0.896
½K_2CO_3	0.426 normal	0.914
½Na_2CO_3	"	0.932

(Riesenfeld, Z. phys. Ch. 1903, **45.** 462.)

The solubility of NH_3 in $NaNO_3$, NH_4NO_3 and in $AgNO_3$,$2NH_3$+Aq is nearly the same as in pure H_2O. (Konowaloff, C. C. **1898, II.** 659).

Distribution-coefficient of NH_3 between water and $CHCl_3$=26.3 at 20°; 24.9 at 25°; 23.2 at 30°.

The distribution-coefficient of NH_3 between $CHCl_3$ and a number of salt solutions has been determined for the purpose of studying the nature of metal-ammonia compounds in aqueous solution. (Dawson, Chem. Soc. 1900, **77.** 1242.)

Distribution of NH_3 between H_2O and $CHCl_3$ at 18°.

NH_3 concentration in aqueous solution. mols./litre	NH_3 concentration in $CHCl_3$ solution. mols./litre
0.9280	0.03506
1.921	0.07703
2.064	0.08350
2.274	0.09317
2.590	0.1083
3.700	0.1639
4.333	0.1996

(Dawson, Z. phys. Ch. 1909, **69.** 120.)

Distribution of NH_3 between hydroxides+Aq and $CHCl_3$ at 18°.

Aqueous solution	NH_3 concentration in the aqueous solution. mols./litre	NH_3 concentration in the $CHCl_3$ solution. mols./litre.
0.2-N. KOH	1.949	0.0841
0.5-N. KOH	1.978	0.0951
0.2-N. NaOH	2.016	0.0869
0.5-N. NaOH	1.944	0.0907
0.2-N. ½$Ba(OH)_2$	2.076	0.08905
0.5-N. ½$Ba(OH)_2$	3.397	0.1560

(Dawson, *l.c.*)

Distribution of NH_3 between $Cu(OH)_2$+Aq and $CHCl_3$ at 18°.

Conc. of $Cu(OH)_2$ equivalents/litre	NH_3 concentration in aqueous solution. mols./litre	NH_3 concentration in $CHCl_3$ solution. mols./litre
0.041	2.014	0.07968
0.0705	2.653	0.1087
0.081	3.011	0.1247

(Dawson, *l.c.*)

Sol. in alcohol and ether.

Sol. in 3 pts. alcohol of 38°. (Boullay.)
1 vol. alcohol of 0.829 sp. gr. absorbs about 50 vols. NH_3. (Davy.)

Much less sol. in ethyl, propyl, or amyl alcohol than in H_2O. (Pagliano and Emo, Gazz. ch. it. **13.** 278.)

Solubility of NH_3 in ethyl alcohol (absolute) at t°.

t°	% NH_3	Pts. NH_3 per 100 pts. alcohol
0	19.7	24.5
6	17.1	20.6
11.7	14.1	16.4
14.7	13.2	15.2
17	12.6	14.7
22	10.9	12.2
28.4	9.2	10.1

(de Bruyn, R. t. c. **11.** 112.)

1 vol. abs. alcohol at 20° and 760 mm. pressure absorbs 340 vols. NH_3 gas. (Müller, W. Ann. 1891, **43.** 567.)

1 l. methyl alcohol sat. with NH_3 contains 218 g. NH_3 at 0°; sp. gr. of solution = 0.770; coefficient of solubility = 425.0. (Delépine).

Solubility of NH_3 in alcohol at t°: weight NH_3 = weight NH_3 contained in a litre of solution sat. at 760 mm. and t°; sp. gr. = sp. gr. of solution; C = coefficient of solubility.

Temp.	Degree of Alcohol	100°	90°	80°	70°	60°	50°
0°	Weight NH_3	130.5	146.0	206.5	.....	246.0	304.5
	Sp. gr.	0.782	0.783	0.808	.....	0.830	0.835
	C	209.5	245.0	390.0	.....	504.5	697.7
10°	Weight NH_3	108.5	120.0	167.0	.....	198.25	227.0
	Sp. gr.	0.787	0.803	0.800	....	0.831	0.850
	C	164.3	186.0	288.0	.....	373.0	438.6
20°	Weight NH_3	75.0	97.5	119.75	137.5	152.5	182.7
	Sp. gr.	0.791	0.788	0.821	0.829	0.842	0.869
	C	106.6	147.8	190.5	223.0	260.8	338.2
30°	Weight NH_3	51.5	74.0	81.75	100.3	129.5	152.0
	Sp. gr.	0.798	0.791	0.826	.....	0.846	0.883
	C	97.0	186.7	121.6	.....	211.6	252.0

(Delépine, J. Pharm. (5) **25.** 496.)

Solubility of NH_3 in methyl alcohol (absolute) at t°.

t°	% NH_3	Pts. NH_3 per 100 pts. alcohol
0	29.3	41.5
6	26.0	35.2
11.7	23.5	30.7
14.7	21.8	27.9
17	20.8	26.3
22	18.3	22.4
28.4	14.8	17.4

(de Bruyn, *l.c.*)

Readily sol. in ether.

Sol. in 0.4 vol. petroleum from Amiano. (Saussure.)

1 vol. oil of turpentine absorbs 7.5 vols. NH_3 at 16°.

1 vol. oil of lemon absorbs 8.5 vols. NH_3 at 16°.

1 vol. oil of rosemary absorbs 9.75 vols. NH_3 at 29°.

1 vol. oil of lavender absorbs 47 vols. NH_3 at 20°. (Saussure.)

1 vol. caoutchine absorbs 3 vols. NH_3. (Himly.)

Valerol absorbs much NH_3. (Gerhardt, A. ch. (3) **7.** 278.)

1 vol. ether at 760 mm. pressure absorbs 17.13 vols. NH_3 at 0°; 12.35 vols. at 10° and 10.27 vols. at 15°. (Christoff, Z. phys. Ch. 1912, **79.** 459.)

$+H_2O$. Colorless crystals.

$+\frac{1}{2}H_2O$. Large transparent crystals. (Rupert, J. Am. Chem. Soc. 1909, **31.** 868.)

Ammonia, with metal salts.

For the ammonia addition-products of metal salts, see under the respective metal salts, except in the case of Co, Cr, Hg, and the Pt metals, for which see cobalt ammonium, chromium ammonium, etc., compounds, for

further reference. New data on Co and Cr ammonium compounds and those of the Pt metals, published since the first edition, has not been included in the present edition.

Ammonium amalgam, NH_4, xHg.

Decomp. by H_2O, but more easily in presence of naphtha, alcohol, or ether.

Ammonium azoimide, $N_4H_4=NH_4N_3$.

Easily sol. in H_2O; sl. sol. in absolute alcohol, easily in 80% alcohol. Insol. in ether or benzene. (Curtius, B. **24.** 3344.)

Ammonium cobalt azoimide, NH_4N_3, CoN_6.

Rather sol. in H_2O. (Curtius and Rissom, J. pr. 1898, (2) **58.** 302.)

Ammonium bromide, NH_4Br.

Easily sol. in H_2O with absorption of much heat.

1 pt. NH_4Br dissolves in pts. H_2O at t°.

t°	Pts. H_2O	t°	Pts. H_2O	t°	Pts. H_2O
10	1.51	30	1.23	100	0.78
16	1.39	50	1.06	...	....

(Eder, W. A. B. **82.** (2) 1284.)

NH_4Br+Aq containing 41.09% NH_4Br is sat. at 15°. (Gerlach.)

Sp. gr. of NH_4Br+Aq at 15°.

% NH_4Br	Sp. gr.	% NH_4Br	Sp. gr.
5	1.0326	20	1.1285
10	1.0652	30	1.1921
15	1.0960	41.09	1.2920

(Eder.)

Sp. gr. of NH_4Br+Aq at 16°.

% NH_4Br	Sp. gr.	% NH_4Br	Sp. gr.
2	1.0119	22	1.1375
3	1.0181	23	1.1440
4	1.0242	24	1.1506
5	1.0303	25	1.1573
6	1.0364	26	1.1642
7	1.0425	27	1.1713
8	1.0486	28	1.1787
9	1.0547	29	1.1862
10	1.0609	30	1.1938
11	1.0672	31	1.2018
12	1.0735	32	1.2098
13	1.0798	33	1.2180
14	1.0862	34	1.2260
15	1.0926	35	1.2342
16	1.0988	36	1.2425
17	1.1051	37	1.2509
18	1.1115	38	1.2594
19	1.1181	39	1.2679
20	1.1246	40	1.2765
21	1.1310	41	1.2850

(Hager, Comm. **1883.**)

25 g. NH_4Br+50 g. H_2O lower the temp. from 15.1° to —1.1°. (Rüdorff.)

Sol. in liquid NH_3 at —50°. (Moissan C. R. 1901, **133.** 713.)

Very sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 826.)

Sl. sol. in alcohol.

1 pt. NH_4Br dissolves in 32.3 pts. alcohol (0.806 sp. gr.) at 15°; 9.5 pts. at 78°. (Eder, *l.c.*)

100 pts. absolute methyl alcohol dissolve 12.5 pts. at 19°; 100 pts. absolute ethyl alcohol dissolve 3.22 pts. at 19°. (de Bruyn, Z. phys. Ch. **10.** 783.)

Solubility in mixtures of methyl and ethyl alcohol at 25°.

P = % methyl alcohol in the solvent.
G = g. NH_4Br in 10 cc. of the solution.
S = sp. gr. of the sat. solution at 25°/4°.

P	G	S
0.00	0.255	0.8065
4.37	0.299	0.8083
10.40	0.321	0.8117
41.02	0.506	0.8252
80.69	0.813	0.8501
84.77	0.847	0.8508
91.25	0.934	0.8551
100.00	0.983	0.8605

(Herz, Z. anorg. 1908, **60.** 156.)

Solubility in mixtures of methyl and propyl alcohol at 25°.

P = % propyl alcohol in the solvent.
G = g. NH_4Br in 10 cc. of the solution.
S = Sp. gr. of the sat. solution at 25°/4°.

P	G	S
0	0.983	0.8605
11.11	0.851	0.8524
23.8	0.690	0.8426
65.2	0.308	0.8184
91.8	0.128	0.8097
93.75	0.125	0.8089
100.	0.095	0.8059

(Herz, *l.c.*)

Solubility in mixtures of propyl and ethyl alcohol at 25°.

P = % propyl alcohol in the solvent.
G = g. NH_4Br in 10 cc. of the solution.
S = Sp. gr. of the sat. solution at 25°/4°.

P	G	S
0	0.255	0.8065
8.1	0.251	0.8062
17.85	0.237	0.8052
56.6	0.163	0.8048
88.6	0.111	0.8042
91.2	0.105	0.8049
95.2	0.104	0.8059
100	0.095	0.8059

(Herz, *l.c.*)

Sol. in 809 pts. ether (0.729 sp. gr.). (Eder, *l.c.*)
Sol. in acetone. (Eidmann, C. C. **1899.** II, 1014); (Naumann, B. 1904, **37.** 4328.)
Insol. in benzonitrile. (Naumann, B. 1914, **47.** 1370.)
Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)
Insol. in ethylacetate. (Naumann, B. 1910, **43.** 314.)

Ammonium *tri*bromide, NH_4Br_3.

Gives off Br in air. Sol. in H_2O. (Roozeboom, B. **14.** 2398.)
Decomp. in the air. Very sol. in H_2O. (Chattaway, Chem. Soc. 1915, **107.** 106.)

Ammonium antimony bromide, $3NH_4Br, 2SbBr_3$.

Easily sol. in abs. alcohol. (Caven, C. C. **1905.** II, 293.)
$7NH_4Br, 3SbBr_3$. Easily sol. in abs. alcohol. (Caven, C. C. **1905.** II, 293.)
See also **Bromantimonate, ammonium.**

Ammonium bismuth bromide, $NH_4Br, BiBr_3 + H_2O$.

Deliquescent. Decomp. by H_2O. Sol. in alcohol. (Nicklès, C. R. **51.** 1097.)

Ammonium cadmium bromide, $NH_4Br, CdBr_2 + \frac{1}{2}H_2O$.

Sol. in 0.73 pt. H_2O, 5.3 pts. abs. alcohol, 280 pts. ether (sp. gr. 0.729), and 24 pts. alcohol ether (1 : 1). (Eder, Dingl. **221.** 89.)
Sol. in H_2O without decomp. between 1° and 110.1°.
100 pts. of the solution contain at:

1°	14.8°	52.2°	110.1°	
53.82	58.01	65.32	75.83	pts. of the salt.

(Rimbach, B. 1905, **38.** 1555.)

$4NH_4Br, CdBr_2$. Sol. in 0.96 pt. H_2O, from which it is pptd. by alcohol or ether. (Eder.)
Solubility in H_2O at t°.
Below 160° the salt is decomp. by H_2O; at 160° it is sol. in H_2O without decomp.

t°	100 pts. of the solution contain			Solid phase
	Pts. Cd	Pts. Br	Pts. NH_4	
0.8	14.72	50.46	6.67	Double salt + NH_4Br
13.0	14.94	51.48	6.85	"
44.5	15.01	53.85	7.35	"
76.4	14.60	55.28	7.80	"
123.5	15.50	59.50	8.45	"
160.0	14.70	62.67	9.43	Double salt

(Rimbach, B. 1905, **38.** 1558.)

Not sol. in HBr+Aq without decomp. (Rimbach.)
Not sol. without decomp. in LiBr+Aq, $CaBr_2$+Aq, $MgBr_2$+Aq, $NiBr_2$+Aq, or $CoBr_2$+Aq, even though very conc. solutions are used. Sol. without decomp. in $ZnBr_2$+Aq. (Rimbach, B. 1905, **38.** 1571.)

Ammonium chloromolybdenum bromide, $2NH_4Br, Cl_4Mo_3Br_2$.

Decomp. by pure H_2O. Can be crystallized from HBr+Aq. Apparently sol. without decomp. in alcohol. (Blomstrand.)

Ammonium cuprous bromide.

$4NH_4Br, Cu_2Br_2$. Fairly stable in air.
$2NH_4Br, Cu_2Br_2 + H_2O$. Fairly stable in air. (Wells, Z. anorg. 1895, **10.** 159.)

Ammonium cuprous bromide ammonia, $NH_4Br, Cu_2Br_2, 3NH_3$.

(Fleurent, C. R. 1891, **113.** 1047.)

Ammonium cupric bromide, $2NH_4Br, CuBr_2 + 2H_2O$.

Very sol. in H_2O. (de Koninck, B. **21.** 777 R.)

Ammonium iridium bromide.

See **Bromiridate, ammonium.**

Ammonium iron (ferric) bromide, $(NH_4)FeBr_4 + 2H_2O$.

Very deliquescent; sol. in H_2O. (Walden, Z. anorg. 1894, **7.** 332.)

Ammonium lead bromide, $12NH_4Br, 7PbBr_2 + 7H_2O$.

Decomp. on air, or with cold H_2O. (André, C. R. **96.** 1502.)
$6NH_4Br, PbBr_2 + H_2O$. Decomp. by cold H_2O. (A.)
$7NH_4Br, PbBr_2 + 1\frac{1}{2}H_2O$. Stable on air; decomp. by cold H_2O. (A.)
None of the above compounds exist. (Wells, Sill. Am. J. **146.** 25.)
$2NH_4Br, PbBr_2$. Decomp. by H_2O. Sol. in conc. KOH+Aq and in strong acids. (Fonzes-Diacon, Bull. Soc. 1897, (3) **17.** 351.)
$NH_4Br, 3PbBr_2$. (Wells.)

Ammonium magnesium bromide, $NH_4Br, MgBr_2 + 6H_2O$.

Deliquescent. Sol. in H_2O. (Lerch, J. pr. (2) **28.** 338.)

Ammonium mercuric bromide, $2HgBr_2, NH_4Br$.

Decomp. by H_2O into its constituent salts. (Râу, Chem. Soc. 1902, **81.** 648.)

Ammonium molybdenum bromide, $2NH_4Br, MoBr_3 + H_2O$.

Easily sol. in H_2O. (Rosenheim, Z. anorg. 1905, **46.** 322.)

Ammonium molybdenum bromide chloride.

See **Ammonium chloromolybdenum bromide.**

Ammonium osmium bromide.
See **Bromosmate, ammonium.**

Ammonium osmyl bromide, $(NH_4)_2OsO_2Br_4$.
Sol. in H_2O. (Wintrebert, A. ch. 1903, (7) **28.** 95.)

Ammonium osmyl oxybromide, $(NH_4)_2OsO_3Br_2$.
(Wintrebert, A. ch. 1903 (7) **28.** 117.)

Ammonium palladium bromide.
See **Bromopalladate, ammonium,** *and* **Bromopalladite, ammonium.**

Ammonium platinum bromide.
See **Bromoplatinate, ammonium.**

Ammonium rhodium bromide.
See **Bromorhodite, ammonium.**

Ammonium selenium bromide.
See **Bromoselenate, ammonium.**

Ammonium tellurium bromide.
See **Bromotellurate, ammonium.**

Ammonium thallic bromide, $NH_4Br, TlBr_3+2H_2O$.
Sol. in H_2O. (Willm.)
$+4H_2O$. Efflorescent. Sol. in H_2O. (Nicklès.)
$+5H_2O$. Sol. in H_2O. (Nicklès.)

Ammonium stannous bromide (ammonium bromostannite), $NH_4Br, SnBr_2+H_2O$.
Sol. in H_2O. (Benas, C. C. **1884.** 958.)
$2NH_4Br, SnBr_2$. Sol. in H_2O. (Raymann and Preis, A. **223.** 323.)
$+H_2O$. Sol. in H_2O. (Benas, *l.c.*)
$+2H_2O$. (Richardson, Am. Ch. J. **14.** 96.)
$NH_4Br, 2SnBr_2$(?). (Benas.)

Ammonium stannic bromide, $2NH_4Br, SnBr_4$.
See **Bromostannate, ammonium.**

Ammonium uranyl bromide, $2NH_4Br, UO_2Br_2+2H_2O$.
Very deliquescent, and sol. in H_2O. (Sendtner.)

Ammonium zinc bromide, $2NH_4Br, ZnBr_2$.
Deliquescent, and sol. in H_2O. (Bödeker, J. B. **1860.** 17.)
$+H_2O$. Very deliquescent, and sol. in H_2O. (André, A. ch. (6) **3.** 104.)
$+xH_2O$. (Ephraim, Z. anorg. 1908, **59.** 66.)
$3NH_4Br, ZnBr_2$. Sol. in H_2O. Decomp. only by great dilution. (Jones & Knight, Am. Ch. J. 1899, **22.** 136.)
$+H_2O$. Not hygroscopic. (Ephraim, Z. anorg. 1908, **59.** 66.)

Ammonium bromide arsenic *trioxide*.
See **Arsenite bromide, ammonium.**

Ammonium bromide mercuric chloride, $NH_4Br, 2HgCl_2$.
Ppt. (Rây, Chem. Soc. 1902, **81.** 649.)

Ammonium bromide mercuric iodide, $2NH_4Br, HgI_2$.
Decomp. by H_2O. Sol. in alcohol without decomp. (Grossmann, B. 1903, **36.** 1602.)
$3NH_4Br, 2HgI_2$. Decomp. by H_2O. Sol. in alcohol without decomp. (Grossmann, B. 1903, **36.** 1602.)

Ammonium lead bromochloride, $NH_4Pb_2Br_4Cl$.
Decomp. by H_2C. (Fonzes-Diacon, Bull. Soc. 1897, (3) **17.** 350.)
$NH_4Pb_2Cl_4Br$. Decomp. by H_2O. (Fonzes-Diacon, Bull. Soc. 1897, (3) **17.** 349.)

Ammonium bromochloroiodide, NH_4ClBrI.
Very stable; sol. in H_2O. (Chattaway, Chem. Soc. 1915, **107.** 108.)

Ammonium lead bromoiodide, $NH_4PbBrI_2+2H_2O$ and $NH_4Pb_2BrI_4$.
Decomp. by H_2O. Sol. in conc. KOH+Aq and in strong acids. (Fonzes-Diacon, Bull. Soc. 1897, (3) **17.** 352.)

Ammonium bromiodobromide, NH_4BrIBr.
Decomp. in the air. Sol. in ether. (Jackson, Am. Ch. J. 1900, **24.** 28.)

Ammonium chloride, NH_4Cl.
(Sal-ammoniac.) Not deliquescent. Sol. in H_2O with reduction of temp.

Sol. in 2.24 pts. H_2O. (Wenzel.)
NH_4Cl+Aq sat. at 10° has sp. gr. =1.072. (T.)
Sol. in 2.72 pts. cold, and 1 pt. boiling H_2O. (M. R., and P.)
Sol. in 3 pts. H_2O at 18.75°. (Abl.)
Sol. in 6 pts. cold, and 1 pt. boiling H_2O. (Fourcroy.)
100 pts. H_2O at 18.75° dissolve 36.75 pts. NH_4Cl.
NH_4Cl+Aq sat. at its b.-pt. (114.2°) contains 88.9 pts. NH_4Cl in 100 pts. of the solution. (Berzelius.)
100 pts. H_2O at 15° dissolve 33–36 pts.; and at 100°, 100 pts. NH_4Cl. (Ure's Dict.)
NH_4Cl+Aq sat. at 15° has sp. gr. =1.075209, and contains at least 31.88 pts. NH_4Cl dissolved in every 100 pts. H_2O. (Michel and Krafft, A. ch. (3) **41.** 478.)
NH_4Cl+Aq sat. at 10° contains 23.8% NH_4Cl. (Eller.)
NH_4Cl+Aq sat. in the cold contains 14.3% NH_4Cl. (Fourcroy.)
Sol. in 1 pt. H_2O at 113.5°, b.-pt. of sat. solution. (Griffiths.)
Sol. in 2.7 pts. H_2O at 18.75°, forming a liquid of 1.08 sp. gr. (Karsten, 1840.)
Sol. in 2.727 pts. H_2O at 10°. (Gren's Handbuch.)

100 pts. H_2O at 718 mm. pressure and t° dissolve pts. NH_4Cl.

t°	Pts. NH_4Cl	t°	Pts. NH_4Cl	t°	Pts. NH_4Cl	t°	Pt
0	28.40	30	41.72	60	55.04	90	
10	32.84	40	46.16	70	59.48	100	
20	37.28	50	50.60	80	63.92	110	

(Alluard, C. R. **59.** **500.**)

Solubility in 100 pts. H_2O at t°.

t°	Pts. NH_4Cl	t°	Pts. NH_4Cl	t°	Pts. NH_4Cl	t°	Pts. NH_4Cl
0	29.7	30	41.4	60	55.2	90	71.3
1	30.0	31	41.8	61	55.7	91	71.9
2	30.3	32	42.2	62	56.2	92	72.5
3	30.6	33	42.7	63	56.7	93	73.1
4	31.0	34	43.1	64	57.2	94	73.7
5	31.4	35	43.6	65	57.7	95	74.3
6	31.8	36	44.0	66	58.2	96	74.9
7	32.2	37	44.4	67	58.7	97	75.5
8	32.6	38	44.9	68	59.2	98	76.1
9	33.0	39	45.3	69	59.7	99	76.7
10	33.3	40	45.8	70	60.2	100	77.3
11	33.7	41	46.2	71	60.7	101	78.0
12	34.1	42	46.7	72	61.2	102	78.6
13	34.5	43	47.1	73	61.7	103	79.2
14	34.8	44	47.6	74	62.3	104	79.9
15	35.2	45	48.0	75	62.8	105	80.5
16	35.6	46	48.5	76	63.4	106	81.2
17	36.0	47	49.0	77	63.9	107	81.8
18	36.4	48	49.5	78	64.5	108	82.5
19	36.8	49	49.9	79	65.1	109	83.1
20	37.2	50	50.4	80	65.6	110	83.8
21	37.6	51	50.9	81	66.2	111	84.4
22	38.0	52	51.3	82	66.7	112	85.1
23	38.4	53	51.8	83	67.3	113	85.7
24	38.8	54	52.3	84	67.8	114	86.4
25	39.3	55	52.8	85	68.4	115	87.1
26	39.7	56	53.2	86	69.0	115.65	87.3
27	40.1	57	53.7	87	69.6	....	....
28	40.5	58	54.2	88	70.2	....	....
29	40.9	59	54.7	89	70.7	....	....

(Mulder, calculated from his own and other observations. Scheik. Verhandel. **1864.** 57.)

Solubility in 100 pts. H_2O at t°.

t°	Pts. NH_4Cl	t°	Pts. NH_4Cl	t°	Pts. NH_4Cl
0	29.7	10.8	33.9	64.9	57.9
6.2	32.2	31.6	42.2	90.6	67.2

(Lindström, Pogg. **136.** 315.)

NH_4Cl+Aq sat. at 13–16° contains 26.16% NH_4Cl. (v. Hauer, J. pr. **103.** 114.)

Sol. in 2.72 pts. H_2O at 19°. (Schiff, A. **109.** 326.)

Sol. in 2.803 pts. H_2O at 15°. (Gerlach.)

Sat. NH_4Cl+Aq at 75° contains 38.23% NH_4Cl. (Tschugaeff, Z. anorg. 1914, **86.** 161.)

NH_4Cl+Aq sat. at 30° contains 29.5% NH_4Cl. (Meerburg, C. C. **1904.** II, 1362.)

Solubility in H_2O at t°.

t°	1000 mols. H_2O dissolve mols. NH_4Cl	100 g. H_2O dissolve g. NH_4Cl
3.5	105.2	31.25
25.0	129.7	38.5
50.0	167.0	49.6

(Biltz and Marcus, Z. anorg. 1911, **71.** 169.)

Solubility of NH_4Cl in H_2O at t°.

t°	g. NH_4Cl in 100 g. of the solution	Solid phase
— 0.45	0.7^8	Ice
— 1.25	1.9^8	"
— 1.70	2.7^5	"
— 3.05	4.6	"
— 4.45	6.6^7	"
— 6.4	9.2^3	"
— 8.25	11.4	"
— 9.7	13.1	"
—11.9	15.3	"
—13.25	16.7	"
—14.70	18.1^5	"
—15.4	18.9	"
±—16.0	±19.5	Ice+NH_4Cl
—15.0	19.7	NH_4Cl
—12.2	20.0	"
—10.9	20.3	"
— 7.4	21.1	"
— 5.7	21.7	"
— 2.3	22.3	"
±— 1.1	22.6	"
0	22.7	"

(Meerburg, Z. anorg. 1903, **37.** 203.)

100 g. H_2O dissolve 29.5 g. NH_4Cl at 30.° (Schreinemakers, Arch. neer. Sc. (2) **15.** 17.)

Spec. gravity of NH_4Cl+Aq. G=according to Gerlach at 15° (Z. anal. **8.** 281); S= according to Schiff at 19° (A. **110.** 74).

% NH_4Cl	Sp. gr. G	Sp. gr. S	% NH_4Cl	Sp. gr. G	Sp. gr. S
1	1.00316	1.0029	17	1.05086	1.0495
2	1.00632	1.0058	18	1.05367	1.0523
3	1.00948	1.0087	19	1.05648	1.0551
4	1.01264	1.0116	20	1.05929	1.0579
5	1.01580	1.0145	21	1.06204	1.0606
6	1.01880	1.0174	22	1.06479	1.0633
7	1.02180	1.0203	23	1.06754	1.0660
8	1.02481	1.0233	24	1.07029	1.0687
9	1.02781	1.0263	25	1.07304	1.0714
10	1.03081	1.0293	26	1.07375	1.0741
11	1.03370	1.0322	26.297	1.07658	.....
12	1.03658	1.0351	27	....	1.0768
13	1.03947	1.0380	28	....	1.0794
14	1.04325	1.0409	29	....	1.0802
15	1.04524	1.0438	30	....	1.0846
16	1:04805	1.0467	......	....	......

For older determinations, see Storer's Dict.

Sp. gr. of NH_4Cl+Aq at 18°.

% NH_4Cl	Sp. gr.	% NH_4Cl	Sp. gr.
5	1.0142	20	1.0571
10	1.0289	25	1.0710
15	1.0430	..	.....

(Kohlrausch, W. Ann. **1879.** 1.)

Sp. gr. at 20°/4° of a normal solution of NH_4Cl=1.01454. (Haigh, J. Am. Chem. Soc. 1912, **34.** 1151.)

NH_4Cl+Aq containing 6.52% NH_4Cl has sp. gr. 20°/20°=1.0195. (Le Blanc & Rohland, Z. phys. Ch. 1896, **19.** 272.)

Temp. of maximum density of NH_4Cl+Aq	g. mol. NH_4Cl in 1000 g. H_2O
2.640°	0.1899
0.055°	0.5407

(de Coppet, C. R. 1900, **131.** 178.)

Sp. gr. of dil. NH_4Cl+Aq at 20.004° and 731 mm. (corr.)
Conc.=g. equiv. NH_4Cl per l. at 20.004°.

Conc.	Sp. gr.
0.0000	1.000,000,0
0.0001	1.000,001,8
0.0002	1.000,003,7
0.0005	1.000,009,3
0.0010	1.000,018,5
0.0020	1.000,036,9
0.0050	1.000,091,3
0.0100	1.000,180,3

(Lamb and Lee, J. Am. Chem. Soc. 1913, **35.** 1688.)

Sp. gr. of dil. NH_4Cl+Aq.

NH_4Cl g. in 1000 g. of solution	Sp. gr. 16°/16°
0	1.000000
0.4431	1.000150
0.9061	1.000304
1.8085	1.000606
3.5947	1.001196
7.7845	1.002562
15.3425	1.004994
31.2364	1.010018

(Dijken, Z. phys. Ch. 1897, **24.** 107.)

B.-pt. of NH_4Cl+Aq, containing pts. NH_4Cl to 100 pts. H_2O. G=according to Gerlach (Z. anal. **26.** 439); L=according to Legrand (A. ch. (2) **59.** 436).

B.-pt.	G	L	B.-pt.	G	L
101°	6.5	7.8	109°	50.6	53.5
102	12.8	13.9	110	56.2	59.9
103	19.0	19.7	111	61.9	66.4
104	24.7	25.2	112	67.8	73.3
105	29.7	30.5	113	74.2	80.5
106	34.6	35.7	114	81.3	88.1
107	39.6	41.3	114.2	....	88.9
108	45.0	47.3	114.8	87.1	....

Sat. NH_4Cl+Aq boils at 115.8° at 718 mm. pressure. (Alluard, C. R. **59.** 500.)

NH_4Cl+Aq containing 74.2 pts. NH_4Cl to 100 pts. H_2O forms a crust at 113°; highest temperature observed, 114.8°. (Gerlach, Z. anal. **26.** 426.)

NH_4Cl+Aq containing 10% NH_4Cl boils at 101.7°; 20% NH_4Cl, at 104.4°. (Gerlach.)

NH_4Cl+Aq containing 10.6% NH_4Cl gives off NH_3 at 37°. (Leeds, Am. J. Sci. (3) **7.** 197.)

When NH_4Cl+Aq is boiled, or even evap. on water bath, a little NH_3 is expelled. (Fresenius.)

30 pts. NH_4Cl mixed with 100 pts. H_2O lower the temp. from 13.3° to −5.1°, that is 18.4°. (Rüdorff, B. **2.** 68.)

Freezing-point of sat. solution is −15.4°, the same temp. which is caused by mixing 25 pts. NH_4Cl with 100 pts. snow. (Rüdorff, Pogg. **122.** 337.)

Conc. HCl+Aq precipitates part of NH_4Cl from sat. NH_4Cl+Aq. (Vogel, J. pr. **2.** 199.)

Solubility of NH_4Cl in HCl+Aq at 0°. NH_4Cl =mols. NH_4Cl (in milligrammes) dissolved in 10 cc. of the liquid; HCl= mols. HCl (in milligrammes) dissolved in 10 cc. of the liquid.

NH_4Cl	HCl	Sum of mols.	Sp. gr.
46.125	0.0	46.125	1.076
43.6	2.9	46.5	1.0695
41.0	5.5	46.5	1.0705
39.15	7.85	47.0	1.0715
36.45	10.85	47.30	1.073
27.37	21.4	48.77	1.078
10.875	53.0	63.875	1.106
8.8	61.0	69.8	1.114

(Engel, Bull. Soc. (2) **45.** 655.)

Solubility of NH_4Cl in HCl+Aq.

t°	HCl concentration. g. mol. per 100 g. H_2O	Weight NH_4Cl dissolved in 1000 g. H_2O	Molecular solubility
0°	0	298.40	5.59
"	¼	286.43	5.36
"	½	271.23	5.08
"	1	245.35	4.60
25°	0	395.10	7.40
"	¼	380.85	7.13
"	½	366.00	6.85
"	1	339.05	6.35

(Armstrong & Eyre, Proc. R. Soc. (A.) **84.** 127.)

Solubility in NH_4OH+Aq. NH_4Cl=mols. NH_4Cl (in mgs.) in 10 cc. solution; NH_3=mols. NH_3 (in mgs.) in 10 cc. solution.

NH_4Cl	NH_3	Sp. gr.
46.125	0	1.076
45.8	5.37	1.067
45.5	12.025	1.054
45.125	23.4	1.044
44.5	38.0	1.031
44.0	47	1.025
43.625	54.5	1.017
43.125	80.0	0.993
44.0	90.0	0.992
44.375	95.5	0.983
49.75	130	0.953
60.0	169.75	0.931

(Engel, Bull. Soc. (3) **6.** 17.)

$NH_4Cl+BaCl_2$. 100 pts. H_2O dissolve 33.8 pts. NH_4Cl+11.6 pts. $BaCl_2$ at 20°. (Rüdorff, Pogg. **148.** 467.)

Solubility of NH_4Cl and $BaCl_2$ in H_2O.

t°	Wt. per 100		Solid phase
	NH_4Cl	$BaCl_2$	
—16.2°	16.10	8.07	$NH_4Cl+BaCl_2.2H_2O$
0	19.26	8.22	
30	24.89	8.19	
40	26.93	8.40	
50	29.53	8.55	

(Schreinemakers, Chem. Weekbl. 1910, **7.** 333.)
See also $BaCl_2+NH_4Cl$ under $BaCl_2$.

$NH_4Cl+CdCl_2$. Solubility of NH_4Cl and $CdCl_2$.
See **Ammonium cadmium chloride.**

$NH_4Cl+CuCl_2$. Solubility of NH_4Cl in H_2O at 30° in presence of varying amounts of $CuCl_2$.

% by wt. $CuCl_2$	% by wt. NH_4Cl	Solid phase
0	29.5	NH_4Cl
1.9	28.6	$NH_4Cl+CuCl_2, 2NH_4Cl. 2H_2O$
3.6	25.9	$CuCl_2, 2NH_4Cl. 2H_2O$
7.7	19.8	"
10.5	16.5	"
12.3	14.9	"
15.6	12.1	"
19.9	9.4	"
24.0	7.1	"
29.4	4.9	"
35.1	3.4	"
41.4	2.1	"
43.2	2.0	$CuCl_2, 2NH_4Cl. 2H_2O+CuCl_2. 2H_2O$
43.9	0.	$CuCl_2. 2H_2O$

(Meerburg, Z. anorg. 1905, **45.** 3)

$NH_4Cl+PbCl_2$. Solubility of NH_4Cl and $PbCl_2$ in H_2O at 22°.

g. equivalent in 1000 g. H_2O		Solid phase
NH_4Cl	$PbCl_2$	
0.0	0.0749	$PbCl_2$
0.1	0.0325	"
0.2	0.0194	"
0.3	0.0153	"
0.4	0.0138	"
0.5	0.0130	"
0.52	0.0127	$PbCl_2+NH_4Cl,2PbCl_2$
0.55	0.0123	$NH_4Cl, 2PbCl_2$
0.6	0.0113	"
0.65	0.0105	"
0.7	0.0099	"
0.8	0.0087	"
0.9	0.0083	"
1.0	0.0080	"
1.2	0.0075	"
1.5	0.0073	"
2.0	0.0077	"
2.5	0.0092	"
3.0	0.0112	"
4.0	0.0182	"
5.0	0.0296	"
6.0	0.0473	"
7.0	0.0774	"
7.29	0.0898	$NH_4Cl+NH_4Cl,2PbCl_2$
7.29	0.0000	NH_4Cl

(Brönstedt, Z. phys. Ch. 1911, **77.** 132.)

Solubility of NH_4Cl and $2PbCl_2,NH_4Cl$ in H_2O at 100°.

NH_4Cl g. equivalent		$PbCl_2$ g. equivalent		Solid phase
in 1000 g. solution	in 1000 g. H_2O	in 1000 g. solution	in 1000 g. H_2O	
1.277	1.404	0.160	0.176	$NH_4Cl+2PbCl_2.H_2O$

(Brönstedt, *l. c.*)

$NH_4Cl+MgCl_2$. Solubility of NH_4Cl and $NH_4MgCl_3.6H_2O$.

t°	In 1000 g. mols. H_2O		Solid phase
	g. mols. NH_4Cl	g. mols. $MgCl_2$	
3.5°	27.5	55.7	$NH_4Cl+NH_4MgCl_3.6H_2O$
25	42.1	56.4	"
50	62.9	59.1	"

(Biltz and Marcus, Z. anorg. 1911, **71.** 170.)

Solubility of $NH_4MgCl_3.6H_2O$ and $MgCl_2.6H_2O$.

t°	In 1000 g. mol. H_2O g. mol. NH_4Cl	g. mol. $MgCl_2$	Solid phase
3.5°	0.5	99.5	$MgCl_2.6H_2O+$ $NH_4MgCl_3.6H_2O$
25°	0.5	103.8	
50°	0.8	111.2	

(Biltz and Marcus, Z. anorg. 1911, **71.** 170.)

$NH_4Cl+NH_4NO_3$. 100 pts. H_2O dissolve 29.1 pts. NH_4Cl+173.8 pts. NH_4NO_3 at 19.5°. (Rüdorff, B. **6.** 482.)

$NH_4Cl+Ba(NO_3)_2$. 100 pts. H_2O dissolve at 18.5°—

	1	2	3	4	5
NH_4Cl	36.7	38.6	38.06	39.18	...
$Ba(NO_3)_2$	....	8.6	16.73	17.02	8.9

2, sat. $Ba(NO_3)_2$+Aq treated with NH_4Cl; 3, sat. NH_4Cl+Aq treated with $Ba(NO_3)_2$; 4, simultaneous treatment of both salts with H_2O. (Karsten.)

$NH_4Cl+KNO_3$. 100 pts. H_2O dissolve at 18.5°—

	1	2	3	4	5	6
KNO_3	29.9	30.56	37.68	38.62	....	34.2
NH_4Cl	....	44.33	37.98	39.84	36.7	38.8
		74.89	75.66	78.46		73.0

1 and 5, according to Mulder; 2, sat. KNO_3+Aq treated with NH_4Cl; 3, sat. NH_4Cl+Aq treated with KNO_3; 4, simultaneous treatment of NH_4Cl and KNO_3 (Karsten); 6, by warming solution with excess of both salts, and cooling to 14.8°. The amount of excess of one or the other salt has no influence. (Rüdorff.)

$NH_4Cl+NaNO_3$. Slowly sol. in sat. $NaNO_3$+Aq, at first to a clear solution, but afterwards NaCl separates out. (Karsten.)

$NH_4Cl+KCl$. 100 pts. H_2O dissolve—

	(Rüdorff) 15°	(Karsten) 18.75°		
KCl	16.97	34.4	16.27	....
NH_4Cl	28.90	....	29.83	37.02

	(Rüdorff) 22°	(Mulder) At b.-pt.		
KCl	19.1	58.5	21.9	....
NH_4Cl	30.4	....	67.7	87.3

100 pts. sat. solution of NH_4Cl+KCl contain 30.61 pts. of the two salts at 13–16°. (v. Hauer, J. pr. **103.** 114.)

$NH_4Cl+NaCl$. 100 pts. H_2O dissolve—

	(Mulder) 10–20°	10°	10°	(v. Hauer) 13–16°
NH_4Cl	....	19.50	33.3	18.8–20.3
NaCl	35.8	30.00	....	24.6–26.1
		49.50		43.4–46.4

	(Karsten) 18.75°		(Rüdorff) 18.7°	(Mulder) At b.-pt.		
NH_4Cl	22.06	37.02	22.9	87.3	78.5	....
NaCl	26.38	....	23.9	...	22.3	40.4
	48.44		46.8		100.8	

Sp. gr. of sat. solution of NH_4Cl+NaCl is 1.179. (Karsten.)

$NH_4Cl+(NH_4)_2SO_4$. 100 pts. H_2O dissolve 26.8 pts. NH_4Cl+46.5 pts. $(NH_4)_2SO_4$ at 21.5°. (Rüdorff, B. **6.** 484.)

Solubility in $(NH_4)_2SO_4$+Aq at 30°.

Composition of the solution % by wt. NH_4Cl	% by wt. $(NH_4)_2SO_4$	Solid phase
0	44	$(NH_4)_2SO_4$
6.86	36.15	"
14.62	28.6	"
17.60	25.69	$(NH_4)_2SO_4+NH_4Cl$
17.93	25.81	"
19.07	23.22	NH_4Cl
19.97	21.3	"
22.3	16.33	"
24.06	12.72	"
29.5	0	"

(Schreinemakers, Z. phys. Ch. 1909, **69.** 562.)

$NH_4Cl+CuSO_4$. Sol. in sat. $CuSO_4$+Aq, at first to a clear solution, but a double sulphate of NH_4 and Cu soon separates. (Karsten.)

$NH_4Cl+MgSO_4$. Slowly and difficultly sol. in sat. $MgSO_4$+Aq with subsequent separation of double sulphate. (Karsten.)

$NH_4Cl+K_2SO_4$. 100 pts. H_2O dissolve, at 18.75°—

		a	*b*	*c*	
K_2SO_4	10.8	11.1	13.26	13.28	....
NH_4Cl	....	38.2	37.94	37.92	36.7
		49.3	51.20	51.20	

In (*a*) NH_4Cl was added to sat. K_2SO_4+Aq. In (*b*) K_2SO_4 was added to sat. NH_4Cl+Aq. In (*c*) NH_4Cl and K_2SO_4 were treated together with H_2O. (Karsten.)

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100 pts. H_2O at 14° dissolve 14.1 pts. K_2SO_4+36.8 pts. NH_4Cl=50.9 pts. $K_2SO_4+NH_4Cl$, under all conditions. (Rüdorff, Pogg. **148.** 565.)

100 pts. H_2O dissolve at b.-pt.—

K_2SO_4 . . .	26.75	33.3– 33.9	. . . .
NH_4Cl . . .	. . . . .	90.4–111.8	87.3
		123.7–145.7	

(Mulder.)

$NH_4Cl+Na_2SO_4$. 100 pts. H_2O dissolve 28.9 pts. NH_4Cl+24.7 pts. Na_2SO_4, if NH_4Cl+Aq sat. at 10° is sat. with Na_2SO_4 at 11°.

100 pts. H_2O dissolve 31.8 pts. NH_4Cl+9.0 pts. Na_2SO_4, if Na_2SO_4+Aq sat. at 10° is sat. with NH_4Cl at 11°. (Mulder, J. B. **1866.** 68.)

Sol. in sat. Na_2SO_4+Aq. (Karsten.)

Sol. in sat. $ZnSO_4$+Aq. (Karsten.)

Sl. sol. in liquid NH_3 at —50°. (Moissan, C. R. 1901, **133.** 713.)

Very sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 826.)

Very sl. sol. in absolute alcohol.

100 pts. alcohol of 0.939 sp. gr. dissolve—

at	4°	8°	27°	38°	56°
	11.2	12.6	19.4	23.6	30.1 pts. NH_4Cl.

(Gerardin, A. ch. (4) **5.** 129.)

14 pts. boiling highest rectified spirit dissolve 1 pt. NH_4Cl. (Wenzel.)

100 pts. alcohol of—

0.900 sp. gr. dissolve 6.5 pts. NH_4Cl.
0.872 " " " 4.75 " "
0.834 " " " 1.5 " "

(Kirwan.)

Though somewhat sol. in pure absolute alcohol, NH_4Cl is absolutely insol. in alcohol in presence of methyl amine chlorides. (Winkles, A. **93.** 324.)

100 pts. absolute methyl alcohol dissolve 3.35 pts. at 19°.

100 pts. absolute ethyl alcohol dissolve 0.62 pt. at 19°. (de Bruyn, Z. phys. Ch. **10.** 783.)

Solubility of NH_4Cl in methyl alcohol.

t°	Alcohol concentration, mol. g. alcohol for 1000 g. H_2O	Solubility in 1000 g. H_2O	Molecular solubility
0°	0	298.40	5.59
"	¼	297.35	5.57
"	½	296.55	5.55
"	1	292.65	5.47
"	3	283.15	5.30
25°	0	395.10	7.40
"	¼	394.75	7.39
"	½	393.85	7.37
"	1	392.90	7.36
"	3	386.20	7.23

(Armstrong and Eyre, Proc. R. Soc. Lond. (A) **84.** 127.)

Solubility of NH_4Cl in ethyl alcohol at 0°.

Alcohol concentration, mol. g. alcohol for 1000 g. H_2O	Solubility in 1000 g. H_2O	Molecular solubility
0	298.40	5.59
¼	295.50	5.53
½	291.95	5.47
1	286.40	5.37
3	266.25	4.99

(Armstrong and Eyre, *l.c.*)

See also **ammonium cupric chloride.**

Solubility of NH_4Cl in propyl alcohol.

t°	Alcohol concentration, mol. g. alcohol for 1000 g. H_2O	Solubility in 1000 g. H_2O	Molecular solubility
0°	0	298.46	5.59
"	¼	295.40	5.53
"	½	291.30	5.45
"	1	284.00	5.32
25°	0	395.10	7.40
"	¼	393.50	7.37
"	½	390.80	7.32
"	1	384.80	7.21

(Armstrong and Eyre, *l.c.*)

Solubility in mixtures of methyl and ethyl alcohol at 25°.

P = % methyl alcohol in the solvent.
G = g. NH_4Cl in 10 cc. of the solution.
S = sp. gr. of the sat. solution at 25°/4°.

P	G	S
0.00	0.0533	0.7908
4.37	0.0583	0.7909
10.40	0.0658	0.7910
41.02	0.118	0.7957
80.69	0.217	0.8020
84.77	0.227	0.8026
91.25	0.247	0.8040
100.00	0.276	0.8062

(Herz, Z. anorg. 1908, **60.** 155.)

Solubility in mixtures of methyl and propyl alcohol at 25°.

P = % propyl alcohol in the solvent.
G = g. NH_4Cl in 10 cc. of the solution.
S = Sp. gr. of the sat. solution at 25°/4°.

P	G	S
0	0.276	0.8062
11.11	0.231	0.8035
23.8	0.182	0.8008
65.2	0.071	0.8005
91.8	0.026	0.8002
93.75	0.023	0.8000
100.00	0.018	0.8009(?)

(Herz, Z. anorg. 1908, **60.** 157.)

Solubility in mixtures of propyl and ethyl alcohol at 25°.

P = % propyl alcohol in the solvent.
G = g. NH_4Cl in 10 cc. of the solution.
S = Sp. gr. of the sat. solution at 25°/4°.

P	G	S
0	0.0533	0.7908
8.1	0.0505	0.7910
17.85	0.0455	0.7916
56.6	0.0312	0.7963
88.6	0.0210	0.7996
91.2	0.0203	0.8001
95.2	0.0190	0.8003
100	0.0177	0.8009

(Herz, Z. anorg. 1908, **60.** 160.)

Insol. in ether and CS_2. (Fordos and Gélis, A. ch. (3) **32.** 393.)

Very sl. sol. in acetone. (Krug and M'Elroy, J. anal. appl. Ch. **6.** 184.)

Solubility of NH_4Cl in acetone+Aq at 25°.

A = cc. acetone in 100 cc. acetone+Aq.
NH_4Cl = millimols. NH_4Cl in 100 cc. of the solution.

A		NH_4Cl	Sp. gr.
0		585.1	1.0793
10		534.1	1.0618
20		464.6	1.0451
30		396.7	1.0263
40		328.5	0.99984
46.5 to 85.7	2 phases, lower	283.7	0.97998
	2 phases, upper	18.9	0.8390
90		9.4	0.8274

(Herz, Z. anorg. 1905, **45.** 263.)

Solubility of NH_4Cl in glycerine+Aq at 25°.

G = g. glycerine in 100 g. glycerine+Aq.
NH_4Cl = millimols. NH_4Cl in 100 cc. of the solution.

G	NH_4Cl	Sp. gr.
0	585.1	1.0793
13.28	544.6	1.0947
25.98	502.9	1.1127
45.36	434.4	1.1452
54.23	403.5	1.1606
83.84	291.4	1.2225
100	228.4	1.2617

(Herz, *l.c.*)

Insol. in acetone. (Naumann, B. 1904, **37.** 4328.); (Eidmann, C. C. **1899.** II, 1014.)

Insol. in anhydrous pyridine. Sol. in 97% pyridine+Aq, 95% pyridine+Aq and in 93% pyridine+Aq. (Kahlenberg, J. Am. Chem. Soc. 1908, **30.** 1107.)

Insol. in CS_2. (Arctowski, Z. anorg. 1894, **6.** 257.)

Very sol. in ethyl amine. (Shinn, J. phys. Chem. 1907, **11.** 538.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Insol. in ethyl acetate. (Naumann, B. 1910, **43.** 314.)

Insol. in benzonitrile. (Naumann, B. 1914, **47.** 1370.)

Sol. in formic acid. (Zanninovich-Tessarin, Z. phys. Ch. 1896, **19.** 251.)

Ammonium antimony chloride, $SbCl_6(NH_4)_2$, $SbCl_6(NH_4)_3$.

Ppt. Decomp. by H_2O. (Weinland, B. 1905, **38.** 1085.)

$SbCl_6(NH_4)$, $SbCl_5$, NH_4OH. Very deliquescent; sl. sol. in H_2O with decomp. (Weinland, B. 1901, **34.** 2635.)

Ammonium antimonous chloride, NH_4Cl, $SbCl_3$.

Deliquescent. (Dehérain, C. R. **52.** 734.)

$2NH_4Cl$, $SbCl_3+2H_2O$. Permanent in dry air; decomp. by much H_2O. (Poggiale.)

$3NH_4Cl$, $SbCl_3+3H_2O$. As above.

Ammonium antimonic chloride, $3NH_4Cl$, $SbCl_5$.

Decomp. by H_2O. (Dehérain, C. R. **52.** 734.)

$4NH_4Cl$, $SbCl_5$. Decomp. by H_2O. (D.)

See also **Chlorantimonate, ammonium.**

Ammonium antimony platinum chloride, $(Sb, Pt)Cl_6(NH_4)_2$.

Ppt. (Weinland, B. 1905, **38.** 1084.)

Ammonium antimony tin chloride, $(Sb,Sn)Cl_6(NH_4)_2$.

Ppt. (Weinland, B. 1905, **38.** 1085.)

Ammonium arsenyl chloride, $2NH_4Cl$, $AsOCl+\frac{1}{2}H_2O$.

(Wallace, Phil. Mag. (4) **16.** 358.)

Ammonium bismuth chloride, NH_4Cl, $2BiCl_3$.

Deliquescent. (Dehérain, C. R. **54.** 724.)

$2NH_4Cl$, $BiCl_3$. Decomp. by H_2O. (Arppe.) Pogg. **64.** 237.)

$+2\frac{1}{2}H_2O$. (Rammelsberg.)

$3NH_4Cl$, $BiCl_3$. Decomp. by H_2O. (Arppe.)

$5NH_4Cl$, $2BiCl_3$. (Rammelsberg.)

Ammonium bismuth potassium chloride, $2NH_4Cl$, $BiCl_3$, KCl.

(Dehérain, C. R. **54.** 724.)

Ammonium cadmium chloride, NH_4Cl, $CdCl_2$.

Solubility of NH_4Cl, $CdCl_2$ in H_2O at t°.

t°	Pts. by weight in 100 pts. of solution: Cl	Cd	NH_4	g. in 100 g. solution	Grams in 100 H_2O	Mols. H_2O free salt dissolved by 100 mols. H_2O
2.4°	13.44	14.26	2.24	29.94	42.74	3.25
16.0	15.07	15.82	2.56	33.45	50.26	3.83
41.2	17.46	18.61	2.89	38.96	63.83	4.86
63.8	19.73	20.92	3.34	43.99	78.54	5.98
105.9	23.52	24.70	4.01	52.58	109.33	8.30

(Rimbach, B. 1897, **30.** 3076.)

$+\frac{1}{2}H_2O$. Sl. sol. in H_2O, alcohol, and wood spirit. (v. Hauer, W. A. B. **13.** 449.)

$4NH_4Cl, CdCl_2$. Sol. in H_2O. (v. Hauer.)

Decomp. by H_2O to $NH_4Cl, CdCl_2$. Decomp. increases with decrease of temp. At 3.9° approximately wholly decomp. to $NH_4Cl, CdCl_2$. At 113.9° very nearly all is $4NH_4Cl, CdCl_2$. (Rimbach, B. 1897, **30.** 3077.)

Solubility of $4NH_4Cl, CdCl_2$ in H_2O at t°.

t°	Pts. dissolved in 100 pts. by weight of solution. Cd	Cl	NH_4
3.9	5.75	18.17	7.37
16.1	6.93	20.26	7.97
40.2	9.91	23.84	8.92
58.5	12.50	26.53	9.35
112.9	16.66	31.79	10.78
113.9	16.51	32.71	11.30

(Rimbach, B. 1897, **30.** 3071.)

Sol. without decomp. in 37.3% HCl(d=1.19) and 24.8% HCl(d=1.125). (Rimbach, B. 1905, **38.** 1569.)

Solubility of $4NH_4Cl, CdCl_2+NH_4Cl$ in H_2O at t°.

t°	In 100 pts. by wt. of the solution			Composition of the solid phase	
	Pts. by wt. Cd	Pts. by wt. Cl	Pts. by wt. NH_4	Mol. % NH_4Cl	Mol. % Tetra-salt
1.0	2.82	17.11	7.82	59.0	41.0
13.2	2.76	18.84	8.71	74.0	26.0
40.1	3.16	22.56	10.49	71.0	29.0
58.2	3.51	25.21	11.72	69.0	31.0

(Rimbach, B. 1902, **35.** 1300.)

Solubility of $4NH_4Cl, CdCl_2+NH_4Cl, CdCl_2$ in H_2O at t°.

t°	In 100 pts. by wt. of the solution			Composition of the solid phase	
	Pts. by wt. Cd	Pts. by wt. Cl	Pts. by wt. NH_4	Mol. % Mono-salt	Mol. % Tetra-salt
1.1	5.34	17.62	7.27	49.6	50.4
14.0	7.12	19.86	7.84	47.0	53.0
40.7	10.24	23.82	8.85	77.0	23.0
58.5	12.50	26.53	9.35	....	....

(Rimbach, B. 1902, **35.** 1300.)

Sol. without decomp. in 50% LiCl+Aq, 33.3% $CaCl_2$+Aq and 50% $MgCl_2$+Aq. (Rimbach, B. 1905, **38.** 1569.)

Ammonium chloromolybdenum chloride, $2NH_4Cl, Cl_4Mo_3Cl_2+2H_2O$.

Decomp. by pure H_2O; can be crystallized from HCl+Aq. (Blomstrand.)

Ammonium chromium chloride, $2NH_4Cl, CrCl_3+H_2O$.

Sol. in H_2O with decomp. (Neumann, A. **244.** 229.)

$+6H_2O = 2NH_4Cl, [CrCl_2.4H_2O]Cl+2H_2O$. Hygroscopic. Decomp. by H_2O and by alcohol. (Weinland, B. 1907, **40.** 3770.)

Ammonium cobaltous chloride, $NH_4Cl, CoCl_2 +6H_2O$.

Deliquescent in moist air. Very easily sol. in H_2O. (Hautz, A. **66.** 284.)

Ammonium cobaltous chloride ammonia, $NH_4Cl, CoCl_2, NH_3$. (F. Rose.)

Ammonium cuprous chloride, $4NH_4Cl.Cu_2Cl_2$. Decomp. in the air.

$4NH_4Cl, 3Cu_2Cl_2$. Decomp. by H_2O, not by alcohol. (Ritthausen, J. pr. **59.** 369.)

Fairly stable in air. (Wells, Z. anorg. 1895, **10.** 158.)

Ammonium cupric chloride, $NH_4Cl, CuCl_2$.

Solubility of $NH_4Cl, CuCl_2$ in absolute alcohol at 25°.

% $CuCl_2$	Solid phase	% $CuCl_2$	Solid phase
4.65	$NH_4Cl+NH_4Cl, CuCl_2$	12.90	$NH_4Cl, CuCl_2$
4.74	$NH_4Cl+NH_4Cl, CuCl_2$	34.92	$NH_4Cl, CuCl_2+CuCl_2, C_2H_5OH$
6.45	$NH_4Cl, CuCl_2$	34.50	"

(Foote and Walden, J. Am. Ch. Soc. 1911, **33.** 1032.)

$+2H_2O$. Sol. in 2 pts. H_2O. (Hautz, A. **66.** 280.)

Does not exist, (Meerburg, C. C. **1904.** II, 1362.

$2NH_4Cl, CuCl_2+2H_2O$. Easily sol. in H_2O, also in alcohol, even when absolute. (Cap and Henry, J. pr. **13.** 184.)

Solubility of $2NH_4Cl, CuCl_2$ in H_2O at t°.

g. $2NH_4Cl, CuCl_2$ in 100 g. of the solution	t°	Solid phase
3.87	—1.5°	ice
5.88	—2.48	"
8.78	—3.95	"
9.97	—4.60	"
13.12	—6.40	"
15.84	—8.04	"
17.64	—9.24	"
20.12	—10.80	"
±20.3	±—11.0	ice+$2NH_4Cl, CuCl_2.2H_2O$
20.46	—10	$2NH_4Cl, CuCl_2.2H_2O$
21.16	—5	"
22.02	0	"
24.26	+12	"
25.95	20	"
27.70	30	"
30.47	40	"
33.24	50	"
36.13	60	"
39.25	70	"
43.36	80	"

(Meerburg, Z. anorg. 1905, **45.** 8.)

Somewhat sol. in liquid NH_3. (Franklin and Kraus, Am. Ch. J. 1898, **20.** 827.)

Is the only hydrate of $2NH_4Cl, CuCl_2$ existing between —11° and +80°. (Meerburg, C. C. **1904.** II, 1362.)

$+3H_2O$. (Bourgeois, Bull. Soc. 1898, (3) **19.** 786.)

Ammonium cupric chloride ammonia, $2NH_4Cl, CuCl_2, 2NH_3$.

Decomp. by H_2O, less easily by alcohol. Decomp. by acids. (Ritthausen.)

Ammonium indium chloride, $2NH_4Cl, InCl_3 + H_2O$.

Easily sol. in H_2O. (Meyer.)

Ammonium iodine chloride, NH_4Cl, ICl_3.

More sol. in H_2O than KCl, ICl_3. (Filhol, J. Pharm. **25.** 441; Berz. J. B. **20.** (2) 110.)

Ammonium iridium *tri*chloride.

See **Chloriridite, ammonium.**

Ammonium iridium *tetra*chloride.

See **Chloriridate, ammonium.**

Ammonium iron (ferrous) chloride, $NH_4Cl, FeCl_2$.

Easily sol. in H_2O; insol. in alcohol. (Winkler.)

Ammonium iron (ferric) chloride, $2NH_4Cl, FeCl_3 + H_2O$.

Deliquescent. Sol. in H_2O without decomp. (Fritzsche); sol. in 3 pts. H_2O at 18.75°. (Abl.)

Sol. in H_2O. (Walden, Z. anorg. 1894, **1.** 332.)

Ammonium iron (ferric) potassium chloride, $NH_4Cl, FeCl_3, KCl + 1\frac{1}{2}H_2O$.

Min. *Kremersite.* Deliquescent.

Ammonium lead chloride, $NH_4Cl, 2PbCl_2 + 3H_2O$.

Sol. in H_2O without decomp. (?). (André, C. R. **96.** 1502.)

$6NH_4Cl, PbCl_2 + H_2O$.

$9NH_4Cl, PbCl_2 + 1\frac{1}{2}H_2O$.

$9NH_4Cl, 2PbCl_2 + 2\frac{1}{2}H_2O$.

$10NH_4Cl, PbCl_2 + H_2O$.

$11NH_4Cl, 2PbCl_2 + 3\frac{1}{2}H_2O$.

$18NH_4Cl, PbCl_2 + 4H_2O$.

All these salts are decomp. by H_2O. (André A. ch. (6) **3.** 104.)

Of the salts prepared by André, only one $NH_4Cl, 2PbCl_2$ exists. (Wells, Sill. Am. J. **146.** 25.)

Solubility determinations show that $NH_4Cl, 2PbCl_2$ is the only double salt formed at 25°. (Foote, Am. Ch. J. 1907, **37.** 121.)

$NH_4Cl, PbCl_2 + \frac{1}{3}H_2O$. (Wells, *l.c.*)

Ammonium lead *tetra*chloride.

See **Chloroplumbate, ammonium.**

Ammonium magnesium chloride, $NH_4MgCl_3 + 6H_2O = NH_4Cl, MgCl_2 + 6H_2O$.

Deliquescent. Very sol. in H_2O.

Sol. in 6 pts. cold H_2O. (Fourcroy.)

Solubility in NH_4Cl+Aq at t°.

t°	Per 1000 Mol. H_2O	
	Mol. NH_4Cl	Mol. $MgCl_2$
3.5°	27.5	55.7
25 0	42.1	56.4
50.0	62.9	59.1

(Biltz, Z. anorg. 1911, **71.** 170.)

$4NH_4Cl, 5MgCl_2 + 33H_2O$. Sol. in H_2O. (Berthelot and André, A. ch. (6) **11.** 294.)

Ammonium manganous chloride, $NH_4Cl, MnCl_2 + \frac{1}{2}H_2O$.

Sol. in $1\frac{1}{2}$ pts. H_2O at ordinary temp. (Hautz, A. **66.** 280); does not exist. (Saunders, Am. Ch. J. **14.** 134.)

$2NH_4Cl, MnCl_2 + H_2O$. Sol. in H_2O (Rammelsberg); does not exist. (Saunders.)

$+2H_2O$. Easily sol. in H_2O, but with decomp. into NH_4Cl and $MnCl_2$. (Saunders.)

Ammonium manganic chloride, $2NH_4Cl, MnCl_3$.

Sol. in H_2O; less sol. in NH_4Cl+Aq. Unstable. (Neuman, M. 1894, **15.** 490.)

$+H_2O$. Decomp. by H_2O. Sol. in HCl apparently without decomp. (Rice, Chem. Soc. 1898, **73.** 260.)

Ammonium mercuric chloride, $2NH_4Cl, HgCl_2 + H_2O$ (sal alembroth).

Sol. in 0.66 pt. H_2O at 10°, and in nearly every proportion of hot H_2O.

$NH_4Cl, HgCl_2$. Easily sol. in H_2O.

$+\frac{1}{2}H_2O$. Easily sol. in H_2O. (Kane.)

$2NH_4Cl, 3HgCl_2 + 4H_2O$. Easily sol. in H_2O. (Holmes, C. N. **5.** 351.)

$NH_4Cl, 2HgCl_2$. Very sol. in H_2O. (Rây, Chem. Soc. 1902, **81.** 648.)

$NH_4Cl, 5HgCl_2$. (Strömholm, J. pr. 1902, (2) **66.** 441.)

Ammonium mercuric sodium chloride, $NH_4Cl, HgCl_2, 4NaCl$ (?).

Sol. in H_2O. (Kossmann, A. ch. (3) **27.** 243.)

Ammonium molybdenum chloride, $2NH_4Cl, MoCl_3 + H_2O$.

Very sol. in H_2O. Nearly insol. in alcohol and ether. (Chilesotti, C. C. **1903.** II, 652.)

See also **Ammonium chloromolybdenum chloride.**

Ammonium molybdenum chloride iodide.

See **Ammonium chloromolybdenum iodide.**

Ammonium molybdenyl chloride, $2NH_4Cl$, $MoO_2Cl_2+2H_2O$.

(Weinland, Z. anorg. 1905, **44.** 98.)

$2NH_4Cl$, $MoOCl_3$. Sol. in H_2O; insol. in H_2O sat. with HCl. (Klason, B. 1901, **34.** 149.

Ammonium nickel chloride, NH_4Cl, $NiCl_2+6H_2O$.

Deliquescent in moist air. Easily sol. in H_2O. (Hautz.)

$4NH_4Cl$, $NiCl_2+7H_2O$ (?).

Ammonium osmium ***tetra*****chloride.**

See **Chlorosmate, ammonium.**

Ammonium osmium ***sesqui*****chloride.**

See **Chlorosmite, ammonium.**

Ammonium osmyl chloride, $(NH_4)_2OsO_2Cl_4$.

Sol. in H_2O. Decomp. by HCl. (Wintrebert, A. ch. 1903, (7) **28.** 92.)

Ammonium osmyl oxychloride, $(NH_4)_2OsO_3Cl_2$.

Very sl. sol. in H_2O. Sol. in KOH+Aq with decomp. (Wintrebert, A. ch. 1903, (7) **28.** 116.)

Ammonium palladium chlorides.

See **Chloropalladate, ammonium** *and* **chloropalladite, ammonium.**

Ammonium rhodium ***di*****chloride,** $4NH_4Cl$, $RhCl_2+3\frac{1}{2}H_2O$.

Sol. in H_2O, but decomp. slowly. (Willm. B. **16.** 3033.)

Does not exist. (Leidié, A. ch. (6) **17.** 277.)

Ammonium rhodium ***tri*****chloride.**

See **Chlororhodite, ammonium.**

Ammonium rhodium chloride ammonium nitrate, Rh_2Cl_6, $6NH_4Cl$, $2NH_4NO_3$.

See **Chlororhodite nitrate, ammonium.**

Ammonium ruthenium ***tri*****chloride.**

See **Chlororuthenite, ammonium.**

Ammonium ruthenium ***tetra*****chloride.**

See **Chlororuthenate, ammonium.**

Ammonium tellurium chloride.

See **Chlorotellurate, ammonium.**

Ammonium thallic chloride, $3NH_4Cl$, $TlCl_3$.

Easily sol. in H_2O. (Willm.)

$+2H_2O$. Easily sol. in H_2O and alcohol. (Nicklès, J. Pharm. (4) **1.** 28.)

Ammonium thorium chloride, $8NH_4Cl$, $ThCl_4+8H_2O$.

Sol. in H_2O. (Chydenius.)

Ammonium tin (stannous) chloride (ammonium chlorostannite), NH_4Cl, $SnCl_2+H_2O$.

Decomp. by H_2O. Resembles K salt. (Richardson, Am. Ch. J. **14.** 93.)

$2NH_4Cl$, $SnCl_2+H_2O$. Sol. in H_2O, but decomp. by boiling. (Rammelsberg.)

Contains $2H_2O$. (Richardson.)

$4NH_4Cl$, $SnCl_2+3H_2O$. Decomp. by H_2O. (Poggiale, C. R. **20.** 1182.)

Does not exist. (Richardson.)

Ammonium tin (stannic) chloride.

See **Chlorostannate, ammonium.**

Ammonium titanium chloride, $2NH_4Cl$, $TiCl_4+2H_2O$.

Ppt.; decomp. in moist air; sol. in fuming HCl; insol. in ether. (Rosenheim, Z. anorg. 1901, **26.** 242.)

Ammonium titanium chloride, $3NH_4Cl$, $TiCl_4$. Sol. in H_2O.

$6NH_4Cl$, $TiCl_4$. Sol. in H_2O. (Rose.)

Ammonium tungsten chloride, $(NH_4)_3W_2Cl_9 = 3NH_4Cl, 2WCl_3$.

Easily sol. in H_2O. Nearly insol. in most organic solvents. (Olsson, B. 1913, **46.** 577.)

Ammonium uranyl chloride.

Very deliquescent, and sol. in H_2O. (Peligot.)

$2NH_4Cl,(UO_2)Cl_2+2H_2O$. Solution at 15° contains in 100 g. 3.51 g., NH_4, 40.67 g. UO_2 and 19.15 g. Cl, hence there is considerable decomp. (Rimbach, B. 1904, **37.** 466.)

Ammonium vanadium chloride, $2NH_4Cl$, VCl_3+H_2O.

Difficulty sol. in H_2O and alcohol. (Stähler, B. 1904, **37.** 4412.)

Ammonium zinc chloride, NH_4Cl, $ZnCl_2+2H_2O$.

Deliquescent. Very sol. in H_2O. (Hautz, A. **66.** 287.)

$2NH_4Cl$, $ZnCl_2$. Sol. in H_2O. (Rammelsberg, Pogg. **94.** 507.)

$+H_2O$. Deliquescent in moist air. Sol. in $^2/_3$ pt. cold H_2O with absorption of heat. Sol. in 0.28 pt. hot H_2O (Golfier-Bassayre, A. ch. **70.** 344); sol. in $\frac{1}{2}$ pt. cold H_2O. (Hautz, A. **66.** 287.)

$3NH_4Cl$, $ZnCl_2$. Sol. in H_2O. (Marignac.)

$+H_2O$. (Berthelot, A. ch. (6) **11.** 294.)

$4NH_4Cl$, $ZnCl_2$. (Dehérain.)

$6NH_4Cl$, $ZnCl_2+^2/_3H_2O$. (Berthelot, *l.c.*)

Ammonium chloride zinc oxychloride, $2ZnCl_2$, $8NH_4Cl$, ZnO.

Sol. in a little H_2O, but decomp. by excess. (André.)

$3ZnCl_2$, $10NH_4Cl$, ZnO. As above. (André, A. ch. (6) **3.** 88.)

Ammonium chloride antimony fluoride, NH_4Cl, SbF_3.

Easily sol. in H_2O. (de Haen, B. **21.** 901 R.)

Ammonium chloride arsenic ***tri*****oxide.**

See **Arsenite chloride, ammonium.**

Ammonium chloride bismuth bromide, $3NH_4Cl, BiBr_3+H_2O$.

Deliquescent; decomp. by H_2O. (Muir, Chem. Soc. **31.** 148.)

$2NH_4Cl, BiBr_3+3H_2O$. Decomp. by H_2O. (Muir.)

$5NH_4Cl, 2BiBr_3+H_2O$. Decomp. by H_2O. (Muir.)

Ammonium chloride chromic oxychloride, $2NH_4Cl, CrOCl_3$.

Decomp. in the air. Sol. in conc. HCl without decomp. (Weinland, B. 1906, **39.** 4045.)

Ammonium chloride cuprocupric thiosulphate, $2NH_4Cl, Cu_2O, CuO, 3S_2O_2$.

See **Thiosulphate ammonium chloride, cuprocupric.**

Ammonium chloride lead iodide, $3NH_4Cl, PbI_2$.

Decomp. with H_2O. (Behrens, Pogg. **62.** 252.)

$4NH_4Cl, PbI_2+2H_2O$. Decomp. with H_2O. (Poggiale, C. R. **20.** 1180.)

Ammonium chloride mercuric bromide, $NH_4Cl, HgBr_2$.

(Edhem-Bey, Dissert. **1885.**)

Ammonium chloride platinum sulphite.

See **Chloroplatosulphite, ammonium.**

Ammonium chloride tin (stannous) bromide, $2NH_4Cl, SnBr_2+H_2O$.

Sol. in H_2O. (Raymann and Preis, A. **223.** 323.)

Ammonium ***di*****chloroiodide,** NH_4Cl_2I.

Slowly decomp. when exposed to dry air at ord. temp. Very sol. in H_2O. (Chattaway, Chem. Soc. 1915, **107.** 107.)

Ammonium ***tetra*****chloroiodide,** NH_4Cl_4I.

Decomp. in the air. (Chattaway, Chem. Soc. 1915, **107.** 107.)

Ammonium lead chloroiodide, $NH_4PbClI_2+2H_2O$ and $(NH_4)_2PbCl_2I_2+2H_2O$.

Sol. in KOH+Aq and in strong acids; decomp. by H_2O. (Fonzes-Diacon, Bull. Soc. 1897, (3) **17.** 348.)

Ammonium fluoride, NH_4F.

Abundantly sol. in H_2O; sl. sol. in alcohol. (Marignac, Ann. Min. (5) **15.** 221.)

Insol. in liquid NH_3. (Ruff and Geisel, B. 1903, **36.** 820.)

Almost insol. in liquid NH_3 at 50°. (Moissan, C. R. 1901, **133.** 713.)

Sol. in methyl alcohol. (Carrara, Gazz. ch. it. 1896, **26.** 119.)

Ammonium hydrogen fluoride, NH_4F, HF.

Deliquescent in moist air. Sol. in H_2O.

Ammonium antimony fluoride, $2NH_4F, SbF_3$.

Deliquescent; sol. in 0.9 pt. cold H_2O. Insol. in alcohol or ether. (Flückinger, A. **84.** 248.)

$NH_4F, 4SbF_3$. 3 pts. sol. in 2 pts. H_2O. (Raad and Hauser, B. 1890, **23.** R. 125.)

NH_4F, SbF_5. Easily sol. in H_2O. (Marignac, A. **145.** 239.)

Ammonium bismuth fluoride, $2NH_4F, BiF_3$.

Insol. in H_2O. Rather difficultly sol. in acids. (Helmholt, Z. anorg. **3.** 115.)

Ammonium cadmium fluoride, NH_4F, CdF_2.

Insol. in H_2O. Sol. in acids on boiling. (Helmholt, Z. anorg. **3.** 115.)

Ammonium chromium fluoride, $3NH_4F, CrF_3$.

Easily sol. in H_2O. Sl. sol. in NH_4F+Aq. (Petersen, J. pr. (2) **40.** 52.)

$2NH_4F, CrF_3+H_2O$. (Wagner, B. **19.** 896.)

Ammonium cobaltous fluoride, $2NH_4F, CoF_2+2H_2O$.

Sl. sol. in H_2O. (Wagner, B. **19.** 896.)

Easily sol. in H_2O. (Helmholt, Z. anorg. **3.** 132.)

Ammonium columbyl fluoride.

See **Fluoxycolumbate, ammonium.**

Ammonium columbium fluoride oxyfluoride, $3NH_4F, CbF_5, CbOF_3$.

See **Fluoxycolumbate columbium fluoride, ammonium.**

Ammonium copper fluoride, $2NH_4F, CuF_2+2H_2O$.

Insol. in H_2O. (Helmholt, Z. anorg. **3.** 115.)

Nearly insol. in H_2O but decomp. thereby. (Haas, Ch. Z. 1908, **32.** 8.)

Ammonium glucinum fluoride, $2NH_4F, GlF_2$.

Sol. in H_2O. (Marignac, A. ch. (4) **30.** 51.)

Very sol. in H_2O. (Helmholt, Z. anorg. **3.** 130.)

Ammonium iron (ferrous) fluoride, $2NH_4F, FeF_2$. (Wagner, B. **19.** 896.)

NH_4F, FeF_2+2H_2O. (W.)

Ammonium iron (ferric) fluoride, $2NH_4F, FeF_3$.

More sol. in H_2O than the corresponding K compound. Decomp. by boiling. (Nicklès, J. Pharm. (4) **7.** 15.)

$3NH_4F, FeF_3$. Sl. sol. in H_2O. (Marignac, A. ch. (3) **60.** 306.)

Easily sol. in acids. (Helmholt, Z. anorg. **3.** 124.)

Ammonium manganic fluoride, $2NH_4F, MnF_4$.

More sol. than the K salt. (Nicklès, C. R **65.** 107.)

True composition is $4NH_4F, Mn_2F_6$. (Christensen, J. pr. (2) **34.** 41.)

See also **Fluomanganate, ammonium.**

Ammonium manganyl fluoride.

See **Fluoxymanganate, ammonium.**

Ammonium molybdenum fluoride.

Insol. in H_2O. Sol. in HCl+Aq. (Berzelius.)

See also **Fluomolybdate, ammonium.**

Ammonium molybdenyl fluoride.

See **Fluoxymolybdate, ammonium.**

Ammonium nickel fluoride, $2NH_4F, NiF_2+2H_2O$.

Sol. in H_2O. (Wagner, B. **19.** 896.)

Easily sol. in H_2O. (Helmholt, Z. anorg. **3.** 143.)

Ammonium scandium fluoride, $(NH_4)_3ScF_6$.

Easily sol. in H_2O. Aqueous solution is not decomp. by boiling. Decomp. by acids. (R. I. Meyer, Z. anorg. 1914, **86.** 275.)

Ammonium silicon fluoride.

See **Fluosilicate, ammonium.**

Ammonium silver fluoride, $2NH_4F, AgF+H_2O$.

Not hydroscopic. Sol. in H_2O; sol. in conc. NH_4F+Aq. Sol. in alcohol. (Grützner, Arch. Pharm. 1900, **238.** 3.)

$15NH_4F, AgF+4H_2O$. More deliquescent than NH_4F. (Böhm, Dissert. **1906.**)

Ammonium tantalum fluoride.

See **Fluotantalate, ammonium.**

Ammonium tantalyl fluoride.

See **Fluoxytantalate, ammonium.**

Ammonium tellurium fluoride, NH_4F, TeF_4.

Decomp. by H_2O. (Högbom, Bull. Soc. (2) **35.** 60.)

Ammonium tin (stannous) fluoride, $2NH_4F, SnF_2+2H_2O$.

Sol. in H_2O. (Wagner, B. **19.** 896.)

Ammonium tin (stannic) fluoride, $2NH_4F, SnF_4$.

See **Fluostannate, ammonium.**

Ammonium titanium ***sesqui*****fluoride.**

See **Fluotitanate, ammonium.**

Ammonium titanyl fluoride.

See **Fluoxypertitanate, ammonium.**

Ammonium tungstyl fluoride.

See **Fluoxytungstate, ammonium.**

Ammonium uranyl fluoride.

See **Fluoxyuranate, ammonium.**

Ammonium vanadium ***sesqui*****fluoride.**

See **Fluovanadate, ammonium.**

Ammonium vanadyl fluoride.

See **Fluoxyvanadate, ammonium.**

Ammonium zinc fluoride, $2NH_4F, ZnF_2$.

Sol. in H_2O. (R. Wagner.)

$+2H_2O$. Very sl. sol. in H_2O. Easily sol. in dil. acids. (Helmholt.)

Ammonium zirconium fluoride.

See **Fluozirconate, ammonium.**

Ammonium fluoride manganic oxyfluoride, $2NH_4F, MnOF_2$.

Precipitate. (Nicklès.)

See also **Fluoxymanganate, ammonium.**

Ammonium fluoride molybdenum ***tri*****oxide,** $2NH_4F, MoO_3$.

Decomp. by H_2O. (Mauro, Gazz. ch. it. **18.** 120.)

Ammonium fluoride tungsten oxyfluoride.

See **Fluoxytungstate, ammonium.**

Ammonium fluoride tungsten oxyfluoride ammonium tungstate, $4NH_4F, WO_2F_2, (NH_4)_2WO_4$.

See **Fluoxytungstate tungstate, ammonium.**

Ammonium fluoride vanadium oxyfluoride.

See **Fluoxyvanadate,** *and* **fluoxyhypovanadate, ammonium.**

Ammonium hydroselenide, NH_4HSe.

Sol. in H_2O with decomp. (Bineau, A. ch. (2) **67.** 229.)

Ammonium hydrosulphide, NH_4SH.

Sol. in H_2O and alcohol. Solutions decomp. on air.

Ammonium hydroxide, NH_4OH.

See **Ammonia,**

Ammonium imidosulphamide, $(S_2O_4N_3H_4)NH_4$.

(Hantzsch, B. 1905, **38.** 1033.)

Ammonium iodide, NH_4I.

Very deliquescent. Sol. in 0.60 pt. H_2O. (Eder, Dingl. **221.** 89.)

Sp. gr. of aqueous solution of NH_4I at 18° containing—

10	20	30	40	50% NH_4I.
1.0652	1.1397	1.2260	1.3260	1.4415

(Kohlrausch, W. Ann. **1879.** 1.)

NH_4I+Aq containing 12.51% NH_4I has sp. gr. 20°/20° = 1.0846.

NH_4I+Aq containing 19.19% NH_4I has sp. gr. 20°/20° = 1.1359.

(Le Blanc and Rohland, Z. phys. Ch. 1896, **19.** 279.)

Very easily sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 826.)

Very sol. in liquid NH_3 at —50°. (Moissan, C. R. 1901, **133.** 713.)

Sol. in $SOCl_2$. (Walden, Z. anorg. 1900, **25.** 216.)

Sol. in liquid SO_2. (Walden, Z. anorg. 1902, **30.** 160.)

Sol. in 4.0 pts. abs. alcohol. (Eder, *l.c.*)
" 210 " ether. (Eder, *l.c.*)
" 20 " alcohol-ether (1 : 1). (Eder, *l.c.*)

Sol. in acetone. (Eidmann, C.C. **1899,** II. 1014.); (Naumann, B. 1904, **37.** 4328.)

Insol. in ethyl acetate. (Naumann, B. 1910, **43.** 314.)

Sl. sol. in benzonitrile. (Naumann, B. 1914, **47.** 1369.)

Ammonium *di*iodide, NH_4I_2.

Sol. in alcohol, ether, CS_2, and KI+Aq; less sol. in chloroform. (Guthrie, Chem. Soc. (2) **1.** 239.)

Ammonium *tri*iodide, NH_4I_3.

Sl. deliquescent. Sol. in little H_2O, but decomp. by much H_2O. (Johnson, Chem. Soc. **33.** 397.)

Ammonium antimony iodide, NH_4I, SbI_3+2H_2O.

Decomp. by H_2O. (Nicklès, C. R. **51.** 1097.)

$3NH_4I$, $4SbI_3+9H_2O$. Decomp. by H_2O, with separation of SbOI. Sol. in $HC_2H_3O_2$, HCl, and $H_2C_4H_4O_6$+Aq. Decomp. by CS_2. (Schäffer, Pogg. **109.** 611.)

$3NH_4I$, SbI_3+3H_2O. As above.

$4NH_4I$, SbI_3+3H_2O. As above.

Ammonium bismuth iodide, NH_4I, BiI_3+H_2O.

Deliquescent; decomp. by H_2O. (Nicklès, C. R. **51.** 1097.)

$4NH_4I$, BiI_3+3H_2O. As above. (Linau, Pogg. **111.** 240.)

$2NH_4I$, $BiI_3+2\frac{1}{2}H_2O$. Decomp. by H_2O, or MCl, MBr, or MI+Aq. (Nicklès, J. pr. (2) **39.** 116.)

Ammonium cadmium iodide, $2NH_4I$, CdI_2+2H_2O.

Deliquescent. (Croft.)

Sol. at 15° in 0.58 pt. H_2O, 0.70 pt. abs. alcohol., 8.9 pts. ether (sp. gr. 0.729), and 1.8 pts. alcohol-ether (1 : 1). (Eder, Dingl. **221.** 89.)

100 pts. of the solution in H_2O contain 85.97 pts. of the salt at 14.5°. (Rimbach, B. 1905, **38.** 1563.)

NH_4I, $CdI_2+\frac{1}{2}H_2O$. Sol. at 15° in 0.90 pt. H_2O, 0.88 pt. abs. alcohol, and 2.4 pts. ether (sp. gr. 0.729). (Eder, *l.c.*)

$+H_2O$. (Grossmann, Z. anorg. 1902, **33.** 154.)

Ammonium chloromolybdenum iodide, $2NH_4I$, $Cl_4Mo_3I_2+2H_2O$.

Decomp. by H_2O. Cryst. from HI+Aq. (Blomstrand.)

Ammonium cuprous iodide, $2NH_4I$, $Cu_2I_2+H_2O$.

Decomp. on the air, or by H_2O, or alcohol. (Saglier, C. R. **104.** 1440.)

$+\frac{1}{2}H_2O$. Decomp. by H_2O with separation of Cu_2I_2. (Gossner, Zeit. Kryst. 1903, **38.** 501.)

Ammonium cupric iodide ammonia, $2NH_4I$, CuI_2, $2NH_3+2H_2O$.

Insol. in H_2O or alcohol; sl. sol. in NH_4OH+Aq.

$+6H_2O$. Unstable. (Saglier, C. R. **104.** 1440.)

NH_4I, $2CuI_2$, $3NH_3$. (Fleurent, C. R. 1891, **113.** 1047.)

Ammonium iridium *di*iodide, $2NH_4I$, IrI_2.

Insol. in cold or hot H_2O, and in alcohol. Sol. in warm dil. acids. (Oppler.)

Ammonium iridium *sesqui*iodide.

See **Iodiridite, ammonium.**

Ammonium iridium *tetra*iodide.

See **Iodiridate, ammonium.**

Ammonium lead iodide, NH_4I, PbI_2+2H_2O.

Decomp. by much H_2O. (Wells, Sill. Am. J. **146.** 25.)

$4NH_4I,3PbI_2+6H_2O$. Sl. sol. in H_2O. (Mosnier, C. R. 1895, **120.** 444.)

Sol. in H_2O with decomp. Sol. in strong KOH+Aq and in strong acids. (Fonzes-Diacon, Bull. Soc. 1897, (3) **17.** 347.)

Ammonium magnesium iodide, NH_4I, MgI_2+6H_2O.

Very deliquescent. (Lerch, J. pr. (2) **28.** 338.)

Ammonium mercuric iodide, NH_4I, HgI_2+H_2O.

Decomp. into its constituents by H_2O. (Boullay, A. ch. (2) **34.** 345.)

Sol. without decomp. in alcohol and ether.

NH_4I, $2HgI_2$. Decomp. by H_2O. Sol. in KI+Aq. Very sol. in alcohol, ether and nitrobenzol. (Löw, Zeit. Kryst, **51.** 138.)

Ammonium silver iodide, $2NH_4I$, AgI.

Deliquescent. Decomp. by H_2O. (Poggiale.)

Ammonium thallic iodide, NH_4I, TlI_3.

Sol. in H_2O. (Nicklès, J. Pharm. (4) **1.** 32.)

Ammonium tin (stannous) iodide, NH_4I, SnI_2.

Decomp. by small amt. H_2O but completely sol. in a large amt. (Boullay, A. ch. (2) **34.** 376.)

$+1\frac{1}{2}H_2O$. (Personne.)

Ammonium zinc iodide, $2NH_4I$, ZnI_2.

Extremely deliquescent, and sol. in H_2O. (Rammelsberg, Pogg. **43.** 665.)

$NH_4I, ZnI_2+4\frac{1}{2}H_2O$. Hydroscopic. (Ephraim, Z. anorg. 1910, **67.** 384.)

Ammonium iodide arsenic *tri*oxide.
See **Arsenite iodide, ammonium.**

Ammonium cobalt nitride.
See **Ammonium cobalt azoimide.**

Ammonium ruthenium *di*hydronitrosobromide, $NO.Ru_2H_2(NH_3)_6Br_3.2HBr$.
Ppt. (Brizard, A. ch. 1900, (7) **21.** 363.)

Ammonium ruthenium nitrosochloride, $3NH_4Cl.2HCl.NORu_2H_2Cl_3$.
Ppt. (Brizard, A. ch. 1900, (7) **21.** 354.)

Ammonium ruthenium *di*hydronitrosochloride, $NO.Ru_2H_2(NH_3)_6Cl_3.2HCl$.
Ppt. (Brizard, A. ch. 1900, (7) **21.** 358.)

Ammonium peroxide, $(NH_4)_2O_2$.
M.-pt. —2°. Sl. sol. in ether without decomp. (D'Ans, B. 1913, **46.** 3076.)
Sol. in alcohol; insol. in ether; decomp. slowly in aq. solution. (Melikoff, B. 1897, **30.** 3145.)

Ammonium hydrogen peroxide, $(NH_4)_2O_2, H_2O_2$.
Decomp. at ordinary temp. (Melikoff, B. 1898, **31.** 447.)
$+H_2O$. Unstable; deliquesces at ordinary temp.; sol. in alcohol; insol. in light petroleum. (Melikoff, B. 1898, **31.** 152.)

Ammonium selenide, $(NH_4)_2Se$.
Sol. in H_2O with decomp. (Bineau, A. ch. (2) **67.** 229.)
Stable in the air. Sol. in H_2O; aq. solution decomp. slowly. (Lenher and Smith, J. Am. Chem. Soc. 1898, **20.** 277.)

Ammonium hydrogen selenide, NH_4HSe.
Sol. in H_2O. (Fabre, C. R. **103.** 269.)

Ammonium *mono*sulphide, $(NH_4)_2S$.
Decomp. on air. Sol. in H_2O, but solution decomposes rapidly.
Very sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 826.)

Ammonium *di*sulphide, $(NH_4)_2S_2$.
Sol. in H_2O with decomp.
Does not exist. (Bloxam, Chem. Soc. 1895, **67.** 293.)

Ammonium *tetra*sulphide, $(NH_4)_2S_4$.
Easily sol. in H_2O. Conc. solution is stable, dil. solution decomp. on air. Easily sol. in alcohol without decomp., but solution decomp. on the air more rapidly than the aqueous solution. (Fritzsche, J. pr. **32.** 313.)
$+\frac{1}{4}H_2O$. When dissolved in H_2O, it is at once dissociated with deposition of S. (Bloxam, Chem. Soc. 1895, **67.** 303.)

Ammonium *penta*sulphide, $(NH_4)_2S_5$.
Decomp. on air. Sol. in H_2O with separation of S. Sol. in alcohol without decomp., but solution decomposes quickly on standing. (Fritzsche, J. pr. **32.** 313.)
Rapidly decomp. by H_2O with separation of S. (Bloxam, Chem. Soc. 1895, **67.** 298.)
$+H_2O$. Decomp. by H_2O with separation of S. (Bloxam, Chem. Soc. 1895, **67.** 298.)

Ammonium *hepta*sulphide, $(NH_4)_2S_7$.
More stable on air, and less easily decomposed by H_2O than $(NH_4)_2S_5$.
$+1^1/_3H_2O$. Decomp. by H_2O with separation of S. Slowly attacked by dil. HCl+Aq. (Bloxam, Chem. Soc. 1895, **67.** 307.)

***Tetr*ammonium *hepta*sulphide,** $(NH_4)_4S_7+4H_2O$.
Sol. in H_2O. Solution can be kept for a long time without depositing S. (Bloxam, Chem. Soc. 1895, **67.** 298.)

***Di*ammonium *ennea*sulphide,** $(NH_4)_2S_9+\frac{1}{2}H_2O$.
Decomposed by H_2O with separation of S. Not attacked by boiling dil. HCl+Aq on account of formation of a hard crust of S on the crystals. (Bloxam, Chem. Soc. 1895, **67.** 306.)

***Tetr*ammonium *ennea*sulphide,** $(NH_4)_4S_9$.
Solution in H_2O deposits crystals of $(NH_4)_2S_5$ on standing. (Bloxam, Chem. Soc. 1895, **67.** 302.)
$+3\frac{1}{2}H_2O$. Decomp. by H_2O with separation of S. (Bloxam, Chem. Soc. 1895, **67.** 299.)

Ammonium *poly*sulphides.
Conc. NH_3+Aq dissolves H_2S to form $(NH_4)_2S,2NH_4SH$. On dilution more H_2S is absorbed to form $(NH_4)_2S,4NH_4SH$, then $(NH_4)_2S,8NH_4SH$, then $(NH_4)_2S,18NH_4SH$ and finally NH_4SH. (Bloxam, Chem. Soc. 1895, **67.** 284.)

Ammonium copper sulphide, $(NH_4)_2S, 2CuS_3$ (?).
Sol. in warm H_2O, but decomp. on standing. Warm KOH+Aq acts similarly; sl. sol. in NH_4OH+Aq, Na_2CO_3+Aq, or absolute alcohol. Insol. in ether. Decomp. by dil. acids. (Priwoznik, B. **6.** 1291.)
Correct formula is NH_4CuS_4. Sl. sol. in H_2O. Decomp. by conc. and dil. acids. Easily sol. in NaOH. Sl. sol. in alcohol. (Biltz, B. 1907, **40.** 976.)

Ammonium gold *poly*sulphide, AuS_3NH_4.
Ppt. (Hofmann, B. 1903, **36.** 3092; B. 1904, **37.** 245.)

Ammonium iridium *pentadeca*sulphide, $IrS_{15}(NH_4)_3$.
Ppt. (Hofmann, B. 1904, **37.** 247.)

Ammonium palladium *undeca*sulphide, $PdS_{11}(NH_4)_2+\frac{1}{2}H_2O$.

Ppt. (Hofmann, B. 1904, **37.** 248.)

Ammonium platinum *pentadeca*sulphide, $PtS_{15}(NH_4)_2+2H_2O$.

Can be washed with CS_2 without decomp. Sol. in alcohol. Insol. in ether. (Hofmann, B. 1903, **36.** 3091.)

Ammonium stannic sulphide.

See **Sulphostannate, ammonium.**

Ammonium telluride, NH_4HTe.

Easily sol. in H_2O. (Bineau, A. ch. (2) **67.** 229.)

Ammonium sulphide ammonia, $(NH_4)_2S$, $2NH_3$.

Very unstable. (Bloxam, Chem. Soc. 1895, **67.** 294.)

Ammonium *aci*sulphomelid, $(NSO.ONH_4)_3$ (?).

(Hantzsch and Stuer, B. 1905, **38.** 1039.)

Ammonplatin*di*amine comps.

See **Platin*tri*amine comps.**

Ammon*di*sulphonic acid, $NH_3(SO_3H)_2$.

Known only in its salts. (Claus, A. **158.** 52 and 194.)

Contains 2 at. H less, and is identical with imidosulphonic acid $NH(SO_3H)_2$, which see. (Raschig, A. **241.** 161.)

Ammon*tri*sulphonic acid, $NH_2(SO_3H)_3$.

Known only in its salts. (Claus, A. **158.** 52 and 194.)

Contains 2 at. H less, and is nitrilosulphonic acid $N(SO_3H)_3$, which see. (Raschig, A. **241.** 161.)

Ammon*tetra*sulphonic acid, $NH(SO_3H)_4$.

Known only in its salts. (Claus, A. **158.** 52 and 194.)

Does not exist, but was impure nitrilosulphonic acid, which see. (Raschig, A. **241.** 161.)

Anhydroarseniotungstic acid, $H_3AsW_8O_{28}$.

See under **Arseniotungstic acid.**

Anhydrooxycobaltamine chloride,

$$Co_2(NH_3)_{10}\left[\begin{matrix}Cl\\O(OH)\end{matrix}\right]Cl_4+H_2O.$$

Easily sol. in H_2O, but decomposes after a few minutes; can be recrystallized from dil. HCl+Aq. Precipitated from sat. H_2O solution by conc. HCl+Aq, or alcohol. (Vortmann, M. Ch. **6.** 404.)

$Co_2(NH_3)_{10}\left(\begin{matrix}Cl\\OH\end{matrix}\right)Cl_4$. Sol. in H_2O. (Vortmann.)

Anhydrooxycobaltamine chloride mercuric chloride, $Co_2(NH_3)_{10}(ClO_2H)Cl_4, 3HgCl_2$.

Can be recryst. from very dil. hot HCl+Aq.

—— **chloroplatinate,** $Co_2(NH_3)_{10}(ClO_2H)Cl_4$, $2PtCl_4$.

Can be recrystallized from H_2O containing HCl.

—— **chloronitrate,** $Co_2(NH_3)_{10}Cl(O.OH)(NO_3)_4+H_2O$.

Can be recrystallized from dil. HCl+Aq.

$Co_2(NH_3)_{10}Cl(O.OH)Cl_2(NO_3)_2+H_2O$. More easily sol. in H_2O than the preceding comp.

—— **chlorosulphate,** $Co_2(NH_3)_{10}Cl(O.OH)(SO_4)_2$.

—— ***di*chromate,** $[Co_2(NH_3)_{10}O.OH]_2(Cr_2O_7)_5+8H_2O$.

Sl. sol. in H_2O.

—— **nitrate,** $Co_2(NH_3)_{10}(NO_3)(O.OH)(NO_3)_4+H_2O$.

Sl. sol. in pure H_2O with immediate decomp. Can be recrystallized from H_2O containing HNO_3.

—— **sulphate,** $[Co_2(NH_3)_{10}O.OH]_2(SO_4)_5$, $2H_2SO_4+2H_2O$.

Sl. sol. in cold H_2O. When crystallized from dil. H_2SO_4+Aq, is converted into—

$[Co_2(NH_3)_{10}O.OH]_2(SO_4)_5,H_2SO_4+3H_2O$, which by further recrystallization from very dil. H_2SO_4+Aq becomes—

$[Co_2(NH_3)_{10}O.OH]_2(SO_4)_5+8H_2O$. Sl. sol. in cold H_2O. (Vortmann.)

Anhydrophospholuteotungstic acid, $H_3PW_9O_{28}$.

See under **Phosphotungstic acid.**

Antimonic Acid.

***Met*antimonic acid,** $HSbO_3$.

Very sl. sol. in H_2O; sol. in conc. HCl+Aq; sl. sol. in dil. HNO_3+Aq; easily sol. in tartaric acid+Aq; easily sol. in hot KOH, or NaOH+Aq; completely insol. in NH_4OH+Aq. (Fremy, A. ch. (3) **23.** 407.)

Sl. sol. in H_2O. Very sl. sol. in KOH and K_2CO_3+Aq. Insol. in NH_4OH+Aq. Insol. in $HNO_3+H_2SO_4$. Slowly sol. in cold, quickly in hot HCl+Aq. Sl. sol. in tartaric and oxalic acid and in KHC_2O_4+Aq. (Senderens, Bull. Soc. 1899, (3) **21.** 48.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329.)

***Pyro*antimonic acid,** $H_4Sb_2O_7$.

More sol. in H_2O and acids than H_3SbO_4. Sol. in cold NH_4OH, or KOH+Aq. (Fremy.)

Slowly sol. in cold H_2O.

5.88 g. Sb_2O_5 in 1 l. H_2O at 15°
8.55 " " " 1 l. " " 25°
21.30 " " " 1 l. " " 60°

(Delacroix, J. Pharm. 1897, **6.** 337–41.)

Sl. sol. in H_2O. Very sl. sol. in KOH and K_2CO_3+Aq. Insol. in NH_4OH+Aq, and in $HNO_3+H_2SO_4$. Slowly sol. in cold, quickly in hot HCl+Aq. Sl. sol. in tartaric acid, oxalic acid and KHC_2O_4+Aq. (Senderens, Bull. Soc. 1899, (3) **21.** 48.)

*Ortho*antimonic acid, H_3SbO_4.

Sl. sol. in H_2O. Insol. in NH_4OH+Aq. Easily sol. in KOH+Aq. (Fremy.)

Does not exist. (Raschig, B. **18.** 2745.)

Has, however, been prepared by Daubrawa (A. **186.** 110), Conrad (C. N. **40.** 198), and Beilstein and Blaese (Bull. Ac. St. Petersb. **33.** 97).

Very sol. in H_2O. (Delacroix, Bull Soc. 1899 (3) **21.** 1049.)

Very sl. sol. in H_2O, in KOH and K_2CO_3+Aq. Slowly sol. in cold, quickly in hot HCl+Aq. Insol. in NH_4OH+Aq, and in $HNO_3+H_2SO_4$. Sl. sol. in tartaric acid, oxalic acid and KHC_2O_4+Aq. (Senderens, Bull. Soc. 1899, (3) **21.** 52.)

$+\frac{1}{2}H_2O$. (Beilstein and Blaese.)

According to Beilstein and Blaese only one antimonic acid, H_3SbO_4, exists.

*Tetr*antimonic acid, $Sb_2O_5+4H_2O=H_8Sb_2O_9$.

Slowly sol. in cold H_2O.

Solution sat. at t° contains g. Sb_2O_5 per litre—

t°	15°	25°	60°	70°
g. Sb_2O_5	5.88	8.3–8.75	21.30	53.89

Decomp. in solution by heating to 100° or long standing in the cold to Sb_2O_5, $3H_2O$. (Delacroix, Bull. Soc. 1899, (3) **21.** 1049.)

Insol. in H_2O. Very sl. sol. in KOH and K_2CO_3+Aq. Slowly sol. in cold, quickly in hot HCl+Aq. Insol. in NH_4OH+Aq. Insol. in $HNO_3+H_2SO_4$. Sl. sol. in tartaric acid, oxalic acid and in KHC_2O_4+Aq. (Senderens, Bull. Soc. 1899, (3) **21.** 51.)

*Hex*antimonic acid, $Sb_2O_5+6H_2O=H_{12}Sb_2O_{11}$.

Sol. in H_2O to the extent of 22 g. Sb_2O_5 per l. but on standing becomes turbid and a white powder is pptd. until finally only 3 g. Sb_2O_5 are dissolved per l. (Senderens, Bull. Soc. 1899, (3) **21.** 48–49.)

Antimonates.

a. Antimonates. From $HSbO_3$. Some of the K and NH_4 salts are sol. in H_2O, the others are slightly sol. or insol.

β. Pyroantimonates. From $H_4Sb_2O_7$. As a class, insol. in H_2O, but decomp. thereby except in presence of large excess of alkali. (Fremy, A. ch. (3) **12.** 499.)

Probably do not exist. (Beilstein and Blaese.)

Aluminum antimonate, Al_2O_3, $3Sb_2O_5$ (?).

Ppt. Somewhat sol. in excess of Al salts +Aq. Insol. in $K_4Sb_2O_7$+Aq.

$Al(SbO_3)_3+15H_2O=AlH_6(SbO_4)_3+12H_2O$. Ppt. (Beilstein and Blaese, Bull. Ac. St. Petersb. **33.** 101.)

$Al(SbO_3)_3+7H_2O=AlH_6(SbO_4)_3+4H_2O$. Ppt. (B. and B.)

Al_2O_3, $Sb_2O_5+9H_2O$. Ppt. (Ebel, B. **22.** 3043.)

Ammonium antimonate, $NH_4SbO_3+2H_2O$, Insol. in H_2O.

$+2\frac{1}{2}H_2O$. Insol. in H_2O. (Senderens, Bull. Soc. 1899, (3) **21.** 56.)

$+6H_2O$. *See* $(NH_4)_2H_2Sb_2O_7+5H_2O$.

Ammonium *pyro*antimonate, $(NH_4)_4Sb_2O_7$.

Known only in solution.

$(NH_4)_2H_2Sb_2O_7+5H_2O$.

Sol. in H_2O, but decomp. by standing or boiling into insol. salt. Insol. in alcohol. (Fremy, J. pr. **45.** 215). Composition is $NH_4SbO_3+6H_2O$, according to Raschig (B. **18.** 2743).

Barium antimonate, $Ba(SbO_3)_2$.

Ppt. Scarcely sol. in H_2O. Slowly sol. in $BaCl_2$+Aq.

$+2H_2O$. Somewhat sol. in H_2O. Easily sol. in HCl+Aq. (Delacroix, Bull. Soc. 1899, (3) **21.** 1051.)

+5, or $6H_2O$. Ppt.

$BaSb_4O_7+5H_2O$. Sol. in conc. HCl. (Delacroix, Bull. Soc. 1899, (3) **21.** 1051.)

BaO, $3Sb_2O_5+5H_2O$. Insol. in H_2O. Incompletely sol. in HCl. (Delacroix, *l.c.*)

BaO, $4Sb_2O_5+15H_2O$. (Delacroix, *l.c.*)

9BaO, $10Sb_2O_5+18H_2O$. Insol. in HCl+Aq. (Delacroix, *l.c.*)

Bismuth antimonate, $BiSbO_4+H_2O$.

Ppt. Insol. in H_2O; sol. in HCl+Aq. (Cavazzi, Gazz. ch. it. **15.** 37.)

$3Bi_2O_3$, $Sb_2O_5+H_2O$. Insol. in H_2O; sol. in HCl+Aq. (Cavazzi.)

$2Bi_2O_3$, Sb_2O_5. As above. (Cavazzi.)

Cadmium antimonate, $Cd(SbO_3)_2+2H_2O$.

Insol. in H_2O. (Senderens, Bull. Soc. 1899, (3) **21.** 56.)

$+3\frac{1}{2}H_2O$. Very sol. in H_2O. Sol. in HCl +Aq. (Ebel, Dissert. **1890.**)

$+5H_2O$. Insol. in H_2O. (Senderens, *l.c.*)

$+6H_2O$. Ppt. Insol. in H_2O. (Ebel, B. **22.** 3043.)

Calcium antimonate, $Ca(SbO_3)_2$.

Ppt.

$+5H_2O$. Ppt. (Heffter, Pogg. **86.** 418.)

$+6H_2O$. Insol. in H_2O. (Senderens, Bull. Soc. 1899, (3) **21.** 56.)

3CaO, $2Sb_2O_5+6H_2O$. Min. *Ullmanite.*

Chromic antimonate, $Cr(SbO_3)_3+14H_2O$.

Ppt. (Beilstein and Blaese.)

Cobaltous antimonate, $Co(SbO_3)_2+5H_2O$.

Insol. in H_2O. Loses $3H_2O$ in the presence of H_2SO_4 and passes into $Co(SbO_3)_2+2H_2O$,

also insol. in H_2O. (Senderens, Bull. Soc. 1899, (3) **21.** 55.)
$+6H_2O$. Ppt. (Ebel, B. **22.** 3043.)
$+7H_2O$. Sl. sol. in H_2O. Sl. sol. in boiling solutions of cobalt salts.
$+12H_2O$. Ppt. (Heffter, Pogg. **86.** 448.)

Cobaltous hydrogen antimonate, $CoH_4(SbO_4)_2 +H_2O$.
(Gorgeul, Ann. Phys. Beibl. 1897, **21.** 198.)

Cupric antimonate, $3CuO, 2Sb_2O_5$.
Ppt. (Beilstein and Blaese.)
$Cu(SbO_3)_2$. Insol. in H_2O, acids, or alkalies. (Berzelius.)
$+2H_2O$. Insol. in H_2O. (Senderens, Bull. Soc. 1899, (3) **21.** 55.)
$+5H_2O$. Ppt. (Ebel, B. **22.** 3043.)
Insol. in H_2O. (Senderens, *l.c.*)
$CuO, 2Sb_2O_5+9H_2O$. Insol. in H_2O. Sol. in $Sb_2O_5, 4H_2O$+Aq. (Delacroix, Bull. Soc. 1899, (3) **21.** 1054.)
$2CuO, 3Sb_2O_5+10H_2O$. Insol. in H_2O. Sol. in NH_4OH and in *tri*antimonic acid+Aq. (Delacroix, *l. c.*
$CuO, 6Sb_2O_5+16H_2O$. (Delacroix, *l.c.*)

Cupric antimonate ammonia, $Cu(SbO_3)_2, 4NH_3+4H_2O$.
Insol. in H_2O and NH_4OH+Aq. (Schiff, A. **123.** 39.)
$CuSb_2N_3H_{21}O_{12}=Cu(ONH_4)OH, 2(NH_4SbO_3+2H_2O)$. (Raschig, B. **18.** 2743.)
$Cu(SbO_3)_2,3NH_3+9H_2O$. (Delacroix, Bull. Soc. 1901, (3) **25.** 289.)

Glucinum antimonate, $Gl(SbO_3)_2+6H_2O$.
Somewhat sol. in hot H_2O. Easily sol. in warm HCl. (Ebel, Dissert. **1890.**)

Iron (ferrous) antimonate.
Sl. sol. in H_2O. (Berzelius.)

Iron (ferric) antimonate.
Insol. in H_2O. (B.)
$Fe_2O_3, Sb_2O_5+7H_2O$. Ppt. (Ebel, B. **22.** 3043.)
$Fe_2O_3, 2Sb_2O_5+11H_2O$. Ppt. (Beilstein and Blaese.)
$Fe(SbO_3)_3+6\frac{1}{2}H_2O$. Ppt. (B. and B.)

Lead antimonate, basic, $Pb_3(SbO_3)_2(OH)_4+2H_2O=Pb_3(SbO_4)_2+4H_2O$.
Min. *Bleinerite, Bindheimite.*
$2Pb(SbO_3)_2, PbO+11H_2O$. Ppt. (B. and B.)

Lead antimonate, $Pb(SbO_3)_2$.
Insol. in H_2O. Incompletely decomp. by acids. (Berzelius.)
Naples Yellow. Insol. in H_2O.
$+2H_2O$. Insol. in H_2O. (Senderens, Bull. Soc. 1899, (3) **21.** 57.)
$+5H_2O$. Ppt. (Ebel, B. **22.** 3043.)
$+6H_2O$. Ppt. (Beilstein and Blaese.)
$+9H_2O$. Insol. in H_2O. (Senderens, *l.c.*)

Lead antimonate chloride, $Pb(SbO_3)_2, PbCl_2$.
Min. *Nadorite.* Sol. in HCl, HNO_3, and tartaric acid+Aq.

Lithium antimonate, $LiSbO_3$.
Sl. sol. in cold, sol. in hot H_2O, and crystallizes on cooling. Much more sol. than $NaSbO_3$.
$+3H_2O$. Ppt. Sl. sol. in H_2O. (Beilstein and Blaese.)

Magnesium antimonate, $Mg(SbO_3)_2+12H_2O$.
Sol. in hot, less sol. in cold H_2O. (Heffter.)
Sol. in $MgSO_4$+Aq; insol. in $KSbO_3$+Aq. (Berzelius.)

Manganous antimonate, $Mn(SbO_3)_2$.
Difficultly sol. in H_2O.
When heated, is sol. only in strong acids.
$+2H_2O$. Insol. in H_2O. (Senderens, Bull. Soc. 1899, (3) **21.** 56.)
$+5H_2O$. Ppt. (Ebel, B. **22.** 3043.)
$+6H_2O$. Insol. in H_2O. (Senderens, *l.c.*)
$+7H_2O$. Ppt. (Beilstein and Blaese.)

Mercurous antimonate.
Insol. in H_2O. (Berzelius.)

Mercuric antimonate, $Hg(SbO_3)_2$.
Insol. in H_2O, alkalies, and most acids.
Sl. attacked by boiling H_2SO_4, and HCl+Aq.
$+2H_2O$. Insol. in H_2O. (Senderens, Bull. Soc. 1899, (3) **21.** 55.)
$+5H_2O$. Insol. in H_2O. (Senderens.)
$+6H_2O$. Ppt. (Beilstein and Blaese.)

Nickel antimonate, $Ni(SbO_3)_2+2H_2O$.
Insol. in H_2O. (Senderens, Bull. Soc. 1899, (3) **21.** 54.)
$+5H_2O$. Insol. in H_2O. (Senderens.)
$+6H_2O$. Ppt. Insol. in H_2O. (Heffter, Pogg. **86.** 446.)
$+12H_2O$. Sl. sol. in H_2O. (Heffter.)

Potassium antimonate, $KSbO_3$.
Insol. in H_2O. Sol. in warm KOH+Aq, but separates nearly completely on cooling. By boiling with H_2O, or by standing for a long time with cold H_2O, it gradually dissolves as $2KSbO_3+5H_2O$, or $K_2H_2Sb_2O_7+4H_2O$, or $2KH_2SbO_4+3H_2O$.
Insol. in CS_2. (Arctowski, Z. anorg. 1894, **6.** 257.)
$+H_2O$. Insol. in H_2O. (Senderens, Bull. Soc. 1899, (3) **21.** 57.)
$+1\frac{1}{2}H_2O$ ($=2KSbO_3+5H_2O$ of Fremy). Easily sol. in H_2O, especially if warm. Solution is pptd. by NH_4Cl+Aq. (Fremy, A. ch. (3) **12.** 499.)
$+2\frac{1}{2}H_2O$. 100 pts. H_2O at 20° dissolve 2.81 pts. anhydrous salt; sp. gr. of solution sat. at 18°=1.0263. Composition is given as $K_2H_2Sb_2O_7+4H_2O$. (Knorre and Olschewsky, B. **20.** 3043.)
$+3\frac{1}{2}H_2O$. Insol. in H_2O. (Senderens, *l.c.*)

$+4\frac{1}{2}H_2O$. Sol. in H_2O. (Delacroix, J. Pharm. 1897, (6) **6.** 533.)

$2K_2O, 3Sb_2O_5+10H_2O$. Sl. sol. in H_2O. (Delacroix, J. Pharm. 1897, **6.** 337.)

$+10H_2O$. (Delacroix, *l.c.*)

Potassium *pyro*antimonate, $K_4Sb_2O_7$.

Deliquescent; decomp. by boiling with H_2O into $KSbO_3+5H_2O$, by cold H_2O into $K_2H_2Sb_2O_7+6H_2O$. (Fremy.)

Does not exist. (Knorre and Olschewsky.)

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 829.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Insol. in ethyl acetate. (Naumann, B. 1904, **37.** 3601.)

Potassium hydrogen *pyro*antimonate, $K_2H_2Sb_2O_7$.

Insol. in acetone. (Eidmann, C. C. **1899,** II. 1014.)

$+2\frac{1}{2}H_2O$. (Senderens, Bull. Soc. 1899, (3) **21.** 57.)

$+3\frac{1}{2}H_2O$. Very difficultly sol. in hot or cold H_2O. (Knorre and Olschewsky, B. **18.** 2358.)

$+6H_2O$. Quite difficultly sol. in cold H_2O. Not precipitated by NH_4Cl+Aq. Aqueous solution gradually decomposes. (Fremy.)

$+4H_2O$. *See* $2KSbO_3+5H_2O$.

Potassium antimonate sulphantimonate, $KSbO_3, K_3SbS_4+5H_2O$.

Decomp. on air, and with cold H_2O. Sol. in hot H_2O. (Rammelsberg.)

Silver antimonate.

Insol. in H_2O. (Berzelius.)

$AgSbO_3+3H_2O=AgH_2SbO_4+2H_2O$. Easily sol. in NH_4OH+Aq, when freshly pptd. (Beilstein and Blaese.)

$+1\frac{1}{2}H_2O$. Ppt. (Ebel, B. **22.** 3043.)

Silver antimonate ammonia, $AgH_2SbO_4, 2NH_3+H_2O$.

(Beilstein and Blaese.)

Sodium antimonate, $NaSbO_3$.

Sol. in much H_2O, but soon becomes decomposed into $Na_2H_2Sb_2O_7$.

$+3\frac{1}{2}H_2O$, composition of $Na_2H_2Sb_2O_7+6H_2O$, according to Beilstein and Blaese.

1000 pts. H_2O dissolve 0.31 pt. $NaSbO_3+3\frac{1}{2}H_2O$ at 12.3°.

1000 pts. alcohol of 15.8% dissolve 0.13 pt. $NaSbO_3+3\frac{1}{2}H_2O$ at 12.3°.

1000 pts. alcohol of 25.6% dissolve 0.07 pt. $NaSbO_3+3\frac{1}{2}H_2O$ at 12.3°.

Somewhat more sol. when freshly precipitated.

Absolutely insol. in glacial $HC_2H_3O_2$.

Presence of NaOH or Na salts diminish solubility, while NH_4OH or K salts increase it slightly. (Beilstein and Blaese, Bull. Ac. St. Petersb. **33.** 201.)

$+4\frac{1}{2}H_2O$. Sol. in H_2O. (Delacroix, Bull. Soc. 1899, (3) **21.** 1051.)

$2Na_2O, 3Sb_2O_5+10H_2O$. (Delacroix, *l. c.*)

$Na_2O, 3Sb_2O_5+11H_2O$. (Delacroix, *l. c.*)

Sodium *pyro*antimonate, $Na_2H_2Sb_2O_7+6H_2O$.

Boiling H_2O dissolves $\frac{1}{350}$ pt. of this salt. (Fremy.) 1000 pts. H_2O dissolve 2.5 pts. salt. (Ebel, B. **22.** 3044.) *See also* $NaSbO_3+3\frac{1}{2}H_2O$.

$+5H_2O$. (Knorre and Olschewsky.)

Strontium antimonate, $Sr(SbO_3)_2+6H_2O$.

Ppt. Less sol. in H_2O than $SrSO_4$. (Heffter, Pogg. **86.** 418.)

Thallous antimonate, $TlSbO_3+2H_2O=TlH_2SbO_4+H_2O$.

Somewhat sol. in H_2O, when freshly precipitated; insol. when dried. (Beilstein and Blaese.)

Tin (stannous) antimonate, $2SnO, Sb_2O_5$.

Ppt. (Lenssen, A. **114.** 113.)

$Sn(SbO_3)_2+2H_2O$. Attacked with difficulty by acids or alkalies, most easily by hot conc. H_2SO_4. (Schiff, A. **120.** 55.)

$2SnO, 3Sb_2O_5+4H_2O$.

$SnO, 2Sb_2O_5$.

Tin (stannic) antimonate.

Insol. in H_2O. (Levol, A. ch. (3) **1.** 504.)

Uranium antimonate, $5UO_2, 3Sb_2O_5+15H_2O$.

Ppt. Sol. in hot conc. $HCl+Aq$, and in UCl_3+Aq. (Rammelsberg.)

Zinc antimonate, $Zn(SbO_3)_2$.

Very slightly sol. in H_2O (Berzelius); sol. in solutions of Zn salts.

$+2H_2O$. (Ebel, Dissert. **1890.**)

Insol. in H_2O. (Senderens, Bull. Soc. 1899, (3) **21.** 57.)

$+5H_2O$. Not wholly insol. in cold, moderately sol. in hot H_2O. (Ebel, Dissert. **1890.**)

$+6H_2O$. Insol. in H_2O. (Senderens.)

Antimoniomolybdic acid.

Ammonium antimoniomolybdate, $5(NH_4)_2O, 4Sb_2O_5, 7MoO_3+12H_2O$.

Readily sol. in hot H_2O. (Gibbs, Am. Ch. J. **7.** 392.)

Antimoniotungstic acid, $3Sb_2O_5, 4WO_3+11H_2O$.

Sol. in H_2O. (Hallopeau, C. R. 1896, **123.** 1068.)

Potassium antimoniotungstate, $3K_2O, 3Sb_2O_5, 4WO_3+4H_2O$.

Much more sol. in hot than in cold H_2O. Decomp. by HCl, H_2SO_4 and HNO_3. (Hallopeau, C. R. 1896, **123.** 1066.)

$+16H_2O$. Much more easily sol. in hot than cold H_2O. Decomp. by HCl, H_2SO_4, and HNO_3. (Hallopeau, *l.c.*)

$6K_2O, 4Sb_2O_5, 12WO_3+25H_2O$.

Sl. sol. in H_2O. (Gibbs, Am. Ch. J. **7.** 392.)

Antimoniuretted hydrogen.

See **Antimony hydride.**

Antimonosomolybdic acid.

Ammonium antimonosomolybdate, $6(NH_4)_2O, 3Sb_2O_3, 17MoO_3+21H_2O$.

Insol. in cold H_2O. (Gibbs, Am. Ch. J. **7.** 313.)

Antimonosophosphotungstic acid.

Potassium antimonosophosphotungstate, $12K_2O, 5Sb_2O_3, 6P_2O_5, 22WO_3+48H_2O$.,

Nearly insol. in cold or warm H_2O. (Gibbs, Am. Ch. J. **7.** 392.)

Antimonosotungstic acid.

Ammonium antimonosotungstate.

Sol. in H_2O.

Barium antimonosotungstate, $4BaO, 6Sb_2O_3, 22WO_3+36H_2O$.

Precipitate; very sl. sol. in hot H_2O. (Gibbs, Am. Ch. J. **7.** 313.)

Antimonous acid, $HSbO_2$.

(Long, J. Am. Chem. Soc. 1895, **17.** 87.)

$+1\frac{1}{2}H_2O$. Ppt. (Schaffner, A. **51.** 182.)

H_3SbO_3. Ppt. (Clarke and Stallo, B. **13.** 1793.)

Does not exist. (Guntz, C. R. **102.** 1472.)

$H_4Sb_2O_5$. When freshly pptd., is sol. in dil. KOH, and NaOH+Aq. Scarcely sol. in NH_4OH+Aq, or in $(NH_4)_2CO_3$, or $KHCO_3$+Aq.

Completely sol. in K_2CO_3, and Na_2CO_3+Aq, especially if warm. When recently pptd. is sl. sol. in succinic acid+Aq.

Calcium antimonite, $CaSb_2O_4$ (?).

Min. *Romeite.* Insol. in acids.

Cobaltous antimonite (?).

Sl. sol. in H_2O. (Berzelius.)

Cuprous antimonite, $Cu_6(SbO_3)_2$.

Insol. in H_2O. Sol. in acids; most easily in conc. HCl+Aq. (Hausmann and Stromeyer, Schw. J. **19.** 241.)

Cupric antimonite (?).

Insol. in H_2O. (Berzelius.)

$CuSb_2O_5$. Min. *Ammiolite.*

$CuSb_2O_4$. Sol. in HCl+Aq, tartaric and citric acids. (Harding, Z. anorg. 1899, **20.** 238.)

Iron (ferrous) antimonite (?).

More sol. in H_2O than the antimonate. (Dumas.)

Potassium antimonite, $K_2O, 3Sb_2O_3$.

Easily decomp. by cold H_2O. Not decomp. by KOH+Aq containing over 20.9% K_2O. (Corimimbœuf, C. R. **115.** 1305.)

$+3H_2O$. As above. (C.)

Potassium antimonite iodide, $K_2O, 8Sb_2O_3, 2KI$.

Insol. and not decomp. by cold or hot H_2O. Not decomp. by acids or alkalies. Aqua regia decomp. slowly. Tartaric acid dissolves gradually. (Grühl, Dissert. **1897.**)

Sodium antimonite, $NaSbO_2+3H_2O$.

Difficultly sol. in H_2O. (Terreil, A. ch. (4) **7.** 380.)

$2Na_2O, 3Sb_2O_3+H_2O$. Decomp. by H_2O, but not by NaOH+Aq containing 94.3 g. NaOH per l. (Corimimbœuf.)

$Na_2O, 2Sb_2O_3$. Decomp. by H_2O but not by NaOH+Aq containing 188.6 g. NaOH per l. (C.)

$Na_2O, 3Sb_2O_3$. Decomp. by H_2O, but not by NaOH+Aq containing 113.2 g. NaOH per l. (C.)

$+2H_2O = NaH_2(SbO_2)_3$. (Terreil.)

Antimony, Sb.

Does not decomp. H_2O. Not attacked by HCl+Aq (Berzelius); slowly sol. in conc. HCl+Aq (Debray); slowly sol. in conc. warm HCl+Aq (Troost). Attacked by very conc. HCl+Aq only when finely divided (Schützenberger, Willm); very sl. attacked by dil. or conc. acid (Guntz). Not attacked by boiling HCl+Aq (Gmelin). By careful experiments, pure Sb is absolutely insol. in dil. or conc., hot or cold HCl+Aq, except when in contact with oxygen. (Ditte and Metzner, A. ch. (6) **29.** 389.)

Insol. in dil. or cold conc., but sol. in hot conc. H_2SO_4. Oxidized but not dissolved by HNO_3+Aq. Easily and completely sol. in aqua regia.

Very slowly attacked by pure HNO_3+Aq of 1.51–1.42 sp. gr.; weaker acid has no marked action whether it contains NO_2 or not. HCl+HNO_3 has no action if dil. or at low temp., but when even very dil. and KNO_2 is added, the action will begin. (Millon, A. ch. (3) **6.** 101.)

Not attacked in 10 months by 2% HNO_3+Aq. Sb is not dissolved by HNO_3+Aq of any concentration, a white powder being always left, which is insol. in HNO_3+Aq or H_2O. (Montemartini, Gazz. ch. it. **22.** 384.)

Insol. in alkalies+Aq.

Somewhat sol. in distilled H_2O. More or less sol. in solutions of acids, alkalies and salts and in alcohol and ether. Only sl. sol. in a mixture of alcohol and ether. (Ruff and Albert, B. 1905, **38.** 54.)

Alkaline H_2O_2 converts Sb into antimonic acid, but neutral H_2O_2 is without action. (Clark, Chem. Soc. 1893, **63.** 886.)

Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 826.)

Easily attacked by pyrosulphuryl chloride. (Heumann and Köchlin, B. **16.** 479.)

Sb is sol. in a mixture of HNO_3 and tartaric acid or other polybasic acids. (Czerwek, Z. anal. 1906, **45.** 507.)

Not attacked by a mixture of alcohol and ether. (Cohen, Z. phys. Ch. 1904, **47.** 12.)

½ cc. oleic acid dissolves 0.0007 g. Sb in 6 days. (Gates, J. phys. Ch. 1911, **15.** 143.)

There are three modifications:

1. Ordinary gray metallic.
2. Black amorphous. Unstable at ord. temp. By boiling with H_2O is changed to metallic Sb.
3. Yellow. Very unstable. At —50° goes over rapidly into the ordinary black modification. Sol. in CS_2 at a little above —90°. (Stock, B. 1903, **37.** 898.)

Unstable above —90°. (Stock, B. 1905, **38.** 3837.)

Antimony arsenide, Sb_2As.

(Descamps, C. R. **86.** 1065.)

Antimony *tri*bromide, $SbBr_3$.

Deliquescent; decomp. by H_2O.

Very sol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 826.)

Very sol. in warm liquid $AsBr_3$, forming a solution with sp. gr. = 3.685 at 47°. (Retgers, Z. phys. Ch. 1893, **11.** 339.)

Sol. in S_2Cl_2. (Walden, Z. anorg. 1900, **25.** 217.)

Sol. in $AlBr_3$. (Isbekow, Z. anorg. 1913, **84.** 27.)

Easily sol. in PCl_3 and PBr_3. (Walden, Z. anorg. 1900, **25.** 211.)

Sol. in alcohol and CS_2.

Sol. in ether forming two layers. (Hayes, J. Chem. Soc. 1902, **24.** 360.)

Sol. in acetone. (Naumann, B. 1904, **37.** 4328.)

Solubility of $SbBr_3$ in organic liquids.
Data in parentheses indicate labile equilibrium.

Solvent	t°	Mols. per 100	t°	Mols. per 100	t°	Mols. per 100
Benzene	5.6°	0	65°	17.1	91.5°	73.7
	4.5	1.9	75	24.9	90	76.7
	15	3.0	80	30.7	85	84.9
	25	4.3	85	38.4	90	91.4
	35	6.0	90	48.2	92	94.8
	45	8.6	91.5	58.1	94	100
	55	12.1	92.5	66.6		
Chlorbenzene	—45.2°	0	0°	7.2	60°	37.6
	—47	1.7	10	9.2	70	50.0
	—40	2.2	20	11.8	80	66.6
	—30	3.2	30	15.4	90	89.6
	—20	4.3	40	20.8	94	100
	—10	5.6	50	28.1		
Brombenzene	—31°	0	15°	17.4	75°	65.2
	—32	2.6	25	22.2	85	81.1
	—25	4.4	35	22.7	90	90.0
	—15	6.9	45	34.4	94	100
	— 5	9.9	55	42.6		
	5	13.4	65	52.6		

Solubility of $SbBr_3$ in organic liquids.—*Cont.*

Solvent	t°	Mols. per 100	t°	Mols. per 100	t°	Mols. per 100
Iodbenzene	—28.6°	0	10°	26.3	70°	67.0
	—30.5	4.0	20	31.5	80	78.2
	—32	8.7	30	37.3	90	91.9
	—20	13.5	40	43.7	94	100
	—10	17.5	50	50.7		
	0	21.7	60	58.5		
Paradichlorbenzene	54.5°	0	65°	29.5	85°	68.9
	51.5	6.3	70	37.0	90	85.2
	48.5	12.8	75	45.6	94	100
	55	18.7	80	56.2		
Paradibrombenzene	88°	0	65°	52.0	90°	91.8
	85	6.8	70	59.1	92	95.4
	80	18.0	75	66.5	94	100
	75	29.5	80	74.4		
	70	41.5	85	83.0		
Nitrobenzene	6°	0	—5°	32.3	55°	59.1
	1	8.6	5	35.3	65	66.4
	— 4	17.0	15	38.8	75	74.9
	— 9	24.0	25	42.8	85	86.0
	—15	29.7	35	47.4	90	93.0
	(—17)	(31.9)	45	52.8	94	100
Metadinitrobenzene	90°	0	55°	49.1	70°	70.8
	85	8.1	50	53.0	75	76.0
	80	16.2	47.5	54.4	80	81.7
	75	24.2	50	56.1	85	87.8
	70	31.8	55	58.8	90	94.2
	65	38.5	60	62.2	94	100
	60	44.3	65	66.2		
Toluene	—93°	0	10°	28.8	70°	69.4
	—93.5	0.3	20	36.7	80	79.4
	—70	1.2	30	47.5	85	85.2
	—50	2.6	(34)	(54.0)	90	92.6
	—30	5.2	40	51.5	94	100
	—10	13.3	50	56.3		
	— 1	22.4	60	62.3		
Ethylbenzene	—93°	0.1	10°	9.8	60°	59.8
	—60	0.4	20	19.5	70	67.4
	—40	1.0	25	28.6	80	77.4
	—20	2.3	29	37.8	85	85
	—10	3.9	40	44.6	90	92.6
	0	6.4	50	51.6	94	100
Propylbenzene	—80°	0.4	(—1.5°)	(33.3)	50°	44.3
	—60	1.2	(—20)	(23.3)	60	51.5
	—40	3.4	0	25.8	70	61.5
	—30	5.5	10	27.8	80	73.5
	—20	9.5	20	30.5	90	90
	—10	17.2	30	34.1	94	100
	— 5	24.3	40	38.6		
Isoamylbenzene	—70°	1.9	(—13°)	(24.9)	50°	35.8
	—50	3.6	—10	17	60	43.3
	—40	5.1	0	18.2	70	54.0
	—30	7.1	10	19.9	80	68.5
	—20	13.4	20	22.5	90	90
	—17	16.4	30	25.9	94	100
	(—15)	(19.4)	40	30.3		

(Menschutkin, Ann. Inst. Pol. P. le Gr. **13.** 1.)

Antimony bromide with MBr.

See **Bromantimonate, M.**

Also below.

Antimony hydrogen bromide, $SbBr_5$, $HBr + 3H_2O$.

Very hygroscopic. Decomp. by H_2O. (Weinland and Feige, B. 1903, **36.** 256.)

See ***Meta*bromantimonic acid.**

Antimony caesium bromide, $2SbBr_5, 3CsBr+2H_2O$.

Loses Br_2 in the air. (Weinland, B. 1903, **36.** 257.)

Antimony calcium bromide, $SbBr_3, CaBr_2+8H_2O$.

Easily decomp. (Benedict, Proc. Am. Acad. 1895, **30.** 9.)

Antimony glucinum bromide, $3SbBr_5, 2GlBr_2+18H_2O$.

Hydroscopic. Easily decomp. (Weinland, B. 1903, **36.** 258.)

Antimony magnesium bromide, $SbBr_3, MgBr_2+8H_2O$.

As Ca salt. (Benedict, Proc. Am. Acad. 1895, **30.** 9.)

Antimony potassium bromide, $10SbBr_3, 23KBr+27H_2O$.

(Herty, Am. Ch. J. 1894, **16.** 496.)

Antimony rubidium bromide, $2SbBr_3, 3RbBr$.

Decomp. by H_2O; can be recryst. from dil. HBr+Aq. (Wheeler, Z. anorg. **5.** 258.)

$SbRb_2Br_6$. Slowly loses Br_2 in the air. Decomp. by H_2O. (Weinland, B. 1903, **36.** 259.)

$10SbBr_3, 23RbBr$ (?). Cryst. from conc. HBr+Aq. (Wheeler.)

The composition assigned to this salt by Wheeler (Z. anorg. **5.** 253) is incorrect. (Ephraim, B. 1903, **36.** 1817.)

Antimony vanadium bromide, $SbBr_3, VBr_4+7H_2O$.

Hydroscopic. Decomp. by H_2O. Sol. in dil. HCl and in tartaric acid. (Weinland, B. 1903, **36.** 260.)

Antimony bromide potassium chloride, $SbBr_3, 3KCl+1\frac{1}{2}H_2O$.

Slowly deliquescent. Very sol. in H_2O.

Sat. solution contains 120.5 g. to 100 cc. H_2O, and has sp. gr. = 1.9.

Decomp. by much H_2O. (Atkinson, Chem. Soc. **43.** 290.)

Does not exist. (Herty, Am. Ch. J. 1894, **16.** 497.)

See also **Antimony chloride potassium bromide.**

Antimony bromofluoride, SbF_5Br.

Decomp. by H_2O. (Ruff, B. 1906, **39.** 4319.)

Antimony ***tri*****chloride,** $SbCl_3$.

Deliquescent. Decomp. by H_2O with precipitation of SbOCl. This precipitation is prevented by tartaric, citric, or hydrochloric acid, or by conc. solutions of chlorides of alkalies and alkaline earths.

Solubility in H_2O.
100 pts. $SbCl_3$ sol. in pts. H_2O at t°.

t°	Pts. H_2O
0°	16.6
15°	12.3
20°	10.9
25°	10.1
30°	9.4
35°	8.7
40°	7.3
50°	5.2
60°	2.2

(Meerburg, Z. anorg. 1903, **33.** 299.)

Solubility in HCl+Aq.
100 mol. H_2O dissolve mol. $SbCl_3$ in presence of mol. HCl at 20°.

Mol. HCl	Mol. $SbCl_3$
0	72.1–72.8
2.4	73.0
6.5	67.5
8.4	67.6
8.6	66.5
9.8	65.0
12.2	65.3
29.6	54.5

(Meerburg, Z. anorg. 1903, **33.** 304.)

Solubility in HCl+Aq.

Solid phase	100 mol. H_2O dissolve at 20°			
	1	2	3	4
	Mol. $SbCl_3$	Mol. HCl	Mol. SbOCl	Mol. HCl
SbOCl	8.7	7.2	9.8	6.9
	8.6	7.5	16.1	7.9
	19.6	8.0	21.7	7.4
	19.8	8.9	25.0	8.8
			28.0	8.6
$(SbOCl)_x,(SbCl_3)_y$	37.5	8.7	32.0	7.9
	44.0	6.8	35.8	7.9
	63.7	6.2	59.5	6.4
	69.1	5.6	61.0	6.5
	66.1	4.6	62.7	4.4
	69.8	5.3		
$SbCl_3$ and $(SbOCl)_x,(SbCl_3)_y$	69.3	4.3		
	68.3	3.6		

1 & 2. (Meerburg, Z. anorg. 1903, **33.** 302.)
3 & 4. (Noodt, Z. anorg. 1903, **33.** 302.)

Somewhat sol. in liquid $(CN)_2$. (Centnerszwer, Bull. Soc. 1901, (3) **28.** 405.)

Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 826.)

Easily sol. in PCl_3 and PBr_3. (Walden, Z. anorg. 1900, **25.** 211.)

Sol. in S_2Cl_2. (Walden, Z. anorg. 1900, **25.** 217.)

Easily sol. in $AsBr_3$. (Walden, Z. anorg. 1902, **29.** 374.)

Sol. in alcohol without decomp. Very sol. in hot CS_2, but solubility diminishes rapidly on cooling. (Cooke, Proc. Am. Acad. **13.** 72.)

1 g. $SbCl_3$ is sol. in 0.186 g. acetone at 18°. Sp. gr. of sat. solution 18°/4° = 2.216. (Naumann, B. 1904, **37.** 4332.)

Sol. in ethyl acetate. (Naumann, B. 1904, **37.** 3601.)

1 pt. sol. in 16.97 pts. of ethyl acetate at 18°. Sp. gr. of sat. solution 18°/4° = 1.7968. (Naumann, B. 1910, **43.** 320.)

Sol. in benzonitrile. (Naumann, B. 1914, **47.** 1369.)

Sol. in methylal. (Eidmann, C. C. **1899,** II. 1014.)

Solubility of $SbCl_3$ in organic liquids.
Data in parentheses indicate labile equilibrium.

Solvent	t°	Mols. per 100	t°	Mols. per 100	t°	Mols. per 100
Benzene	5.6°	0	50°	27.2	75°	78.5
	4	2.6	60	34.7	70	83.3
	1	7.1	70	45.2	62	89.3
	10	10.1	75	53.1	67.5	94.2
	20	13.1	77.5	58.7	73	100
	30	16.8	79	66.6		
	40	21.4	77.5	73.4		
Chlorbenzene	—45.2°	0	—10°	14.4	30°	47.1
	—47	2.2	—5	19.4	40	56.2
	—40	3.6	0	28.1	50	66.6
	—30	6.0	(4)	(41.1)	60	78.7
	—20	9.0	10	32.5	70	94.3
	—15	11.6	20	38.7	73	100
Brombenzene	—31°	0	—5°	21.7	40°	59.2
	—32.5	3.4	0	26.6	50	68.8
	(—35)	(6.4)	3	31.8	60	80.6
	—30	4.8	(6)	(41.9)	65	87.2
	—25	7.6	(7)	(50.0)	70	95.0
	—20	10.7	10	36.4	73	100
	—15	14.1	20	43.2		
	—10	17.8	30	50.8		
Iodbenzene	—28.6°	0	(—5)°	(40.7)	25°	53.9
	—30	2.4	—34.5	10.7	35	60.4
	(—35)	(11.7)	—25	16.4	45	67.5
	(—40)	(20.8)	—15	24.7	55	76.2
	(—45)	(27.2)	—5	39.1	65	87.4
	(—35)	(30.9)	(—3)	(47.2)	70	95.0
	(—25)	(33.9)	5	44.5	73	100
	(—15)	(37.2)	15	48.7		
Paradichlorbenzene	54.5°	0	39.5°	29.5	60°	66.5
	50	6.3	45	37.5	65	78.1
	45	15.5	50	46.4	70	91.1
	40	28.0	55	56.0	73	100
Paradibrombenzene	88°	0	65°	45.4	65°	87.1
	85	5.9	60	53.8	70	95.2
	80	15.8	49.5	64.9	73	100
	75	25.7	55	72.5		
	70	35.7	60	79.8		
Nitrobenzene	6°	0	—13.5°	27.3	15°	59.2
	2	7.0	—10.5	29.8	25	63.0
	—2	12.1	—7.5	35.2	35	67.6
	—6	16.5	—6.5	40.7	45	72.8
	—10	20.3	—6	50.0	55	79.0
	—14	23.5	—6.5	52.8	65	87.2
	(—18)	(26.2)	—5	53.0	70	92.7
	—16.5	25.2	5	55.8	73	100

Solubility of $SbCl_3$ in organic liquids—*Cont.*

Solvent	t°	Mols. per 100	t°	Mols. per 100	t°	Mols. per 100
Metadinitrobenzene	90°	0	(—10°)	(57.7)	(0°)	(78.1)
	80	14.3	(10)	(62.4)	20	65.2
	70	25.3	(27.5)	(44.5)	30	68.8
	60	33.8	(28.5)	(50.0)	40	73.2
	40	45.6	27.5	55.0	50	78.5
	(20)	(53.6)	25	60.2	60	85.8
	(1)	(59.9)	(20)	(66.2)	70	95.2
	(—11)	(62.2)	(10)	(73.5)	73	100
Toluene	—93°	0	—10°	14.4	40°	59.3
	—94	0.5	0	22.1	42.5	66.6
	—70	1.4	6	28.6	40	71.1
	—50	3.3	11	35.7	50	77.1
	—40	5.1	(—8)	(27.0)	60	83.8
	—30	7.2	20	40.5	70	94.7
	—20	10	30	47.6	73	100
Ethylbenzene	—93°	0.1	35°	36.4	(36.8)°	(68.1)
	—50	0.6	39	50	(33)	(65.7)
	—30	1.1	37	57.7	40	70.3
	—10	3.6	35	61.8	50	77.3
	0	5.6	(33)	(65.7)	60	85.5
	10	9.4	(15)	(37.8)	65	90.3
	20	16.8	(25)	(47.5)	70	95.6
	30	27.2	37	66.6	73	100
Propylbenzene	(—70°)	(0.6)	—70°	0.2	8.5°	53.2
	(—50)	(2.8)	—50	1.5	10	53.6
	(—40)	(5.2)	—40	3.0	20	56.9
	(—30)	(8.8)	—30	5.5	30	60.6
	(—20)	(14.8)	—20	9.7	40	65.5
	(—10)	(25.1)	—10	16.2	50	72
	(—5)	(32.4)	—5	20.5	60	81
	(0)	(43.3)	0	26.2	65	86.8
	(1.5)	(50)	5	35.6	70	95.1
	(1)	(51.1)	7	41.6	73	100
Isoamylbenzene	—80°	3	(—45°)	(17.1)	0°	46.3
	—70	5.4	(—35)	(22.8)	10	48.8
	—60	8.4	—25	29.3	20	52.5
	—50	12.4	—15	36.6	30	57.3
	—40	17.9	—5	45.6	40	63.4
	(—30)	(27.3)	(0)	(52.3)	50	71.4
	(—25)	(34.4)	(5)	(60.3)	60	81.7
	(—22)	(40.7)	(7.5)	(66.6)	65	88
	(—20.5)	(50)	(—21)	(44.2)	70	95.5
	(—22)	(54)	(—10)	(44.9)	73	100

(Menschutkin, Ann. Inst. Pol. P.-le Gr., **13.** 1.)

Antimony hydrogen *tri*chloride, $2SbCl_3, HCl + 2H_2O$.

Deliquescent. Decomp. by H_2O.

Melts in crystal H_2O at 16°. (Engel, C. R. **106.** 1797.)

Antimony *penta*chloride, $SbCl_5$.

Deliquesces to $SbCl_5 + 4H_2O$, which can be crystallized out of a little H_2O. Decomp. by more H_2O into SbO_2Cl. Sol. in a large amt. of H_2O, if it is added all at one time. Precipitation by H_2O is also hindered by presence of tartaric, or hydrochloric acid.

$+H_2O$. Deliquescent. Sol. in chloroform. (Anschütz and Evans, A. **239.** 285.)

$+4H_2O$. Insol. in chloroform. (Anschütz and Evans.)

Antimony *penta*chloride with MCl.

See **Chlorantimonate, M.**
See also below.

Antimony hydrogen ***penta*****chloride,** $SbCl_5$, $HCl+4\frac{1}{2}H_2O$.

"*Meta*chlorantimonic acid" according to Weinland and Schmid, (Z. anorg. 1905, **44.** 43.)

Very easily sol. in H_2O, alcohol, acetone and glacial acetic acid. Aqueous solution decomp. on standing with separation of Sb_2O_5 but remains clear in presence of 10% HCl. (Weinland and Schmid, Z. anorg. 1905, **44.** 43.)

$SbCl_5$, $5HCl+10H_2O$. Not deliquescent. Decomp. by H_2O. Melts in crystal H_2O at about 55°. (Engel, C. R. **106.** 1797.)

Antimony antimonyl chloride, $SbCl_3$, $SbOCl$.

More easily attacked by H_2O than SbOCl. (Bemmelen, Z. anorg. 1903, **33.** 293.)

Antimony antimonyl potassium chloride, $SbCl_3$, $SbOCl$, $2KCl$.

Not deliquescent. Immediately decomp. by hot or cold H_2O; sol. in hot glacial $HC_2H_3O_2$, or in HCl, or tartaric acid+Aq.

Insol. in KCl+Aq, hot or cold alcohol, CS_2, or ligroine. (Benedikt, Proc. Am. Acad. **29.** 217.)

Antimony antimonyl rubidium chloride, $SbCl_3$, $SbOCl$, $2RbCl$.

Sol. in very dil. HCl+Aq. (Wells, Am. J. Sci. 1897, (4) **3.** 463.)

Antimony barium chloride, $SbCl_3$, $BaCl_2+{}^3/_2H_2O$.

Decomp. by H_2O.

Antimony cæsium chloride, $SbCl_3$, $6CsCl$.

Decomp. by H_2O. Cryst. from dil. HCl+Aq. (Godeffroy, Arch. Pharm. (3) **12.** 47.)

$2SbCl_3$, $3CsCl$. Decomp. by H_2O; sl. sol. in cold, easily in hot dil. HCl+Aq. This is identical with the above salt. (Saunders, Am. Ch. J. **14.** 152.)

$SbCl_4$, $2CsCl$. Sol. in boiling conc. HCl+Aq without decomp. (Setterberg, Oef. Vet. Akad. 1882, **6.** 23.)

$SbCl_5$, $CsCl$. Cryst. from HCl+Aq without decomp. Decomp. by H_2O. (Setterberg, Oef. Vet. Akad. 1882, **6.** 27.)

Antimony calcium chloride, $SbCl_3$, $CaCl_2+8H_2O$.

Easily decomp. (Benedict, Proc. Am. Acad. 1895, **30.** 9.)

$SbCl_6CaSbCl_5.OH+9H_2O$. Deliquescent; sl. sol. in H_2O. (Weinland, B. 1901, **34.** 2635.)

Antimony chromium chloride,

$CrCl_3$, $3SbCl_5+13H_2O$. (Weinland.) should be

$[SbCl_6]_3[Cr(OH_2)_6]+7H_2O$;

and $CrCl_3$, $SbCl_5+10H_2O$ should be

$[SbCl_6][Cr(OH_2)_4Cl_2]+6H_2O$.

(Pfeiffer, Z. anorg. 1903, **36.** 349.)

Antimony glucinum chloride, $SbCl_3$, $GlCl_2+3H_2O$.

Very hydroscopic. Decomp. by H_2O. Very easily sol. in HCl. (Ephraim, B. 1903, **36.** 1822.)

$+4H_2O$. Ppt. Decomp. by H_2O. Sol. in HCl. (Ephraim, B. 1903, **36.** 1822.)

Antimony hydrazine chloride, $SbCl_3$, $3N_2H_5Cl$.

Sol. in conc. HCl+Aq; decomp. by H_2O. (Ferratini, C. A. **1912,** 1613.)

Antimony lithium chloride, $SbCl_3$, $2LiCl+5H_2O$.

Hydroscopic. Decomp. by H_2O. Very easily sol. in HCl. (Ephraim, B. 1903, **36.** 1821.)

$+6H_2O$. Decomp. by H_2O; easily sol. in HCl. (Ephraim, B. 1903, **36.** 1822.)

Antimony magnesium chloride, $SbCl_3$, $MgCl_2+5H_2O$.

Hydroscopic. Decomp. by H_2O. Can be cryst. from HCl without decomp. (Ephraim, B. 1903, **36.** 1823.)

$2SbCl_3$, $MgCl_2$. Hygroscopic. Decomp. by H_2O. Very sol. in HCl. (Ephraim.)

$SbCl_7MgSbCl_6MgOH+17H_2O$. Hydroscopic. Sol. in H_2O with decomp. (Weinland, B. 1901, **34.** 2635.)

Antimony nitrosyl chloride, $SbCl_5$, $NOCl$.

Very deliquescent; decomp. by pure H_2O; sol. in H_2O containing tartaric acid. (Weber, Pogg. **123.** 347.)

$2SbCl_5$, $5NOCl$. Decomp. by H_2O. (Sudborough, Chem. Soc. **59.** 661.)

Antimony phosphorus chloride, $SbCl_5$, PCl_5.

Deliquescent. (Weber, Pogg. **125.** 78.)

Antimony phosphoryl chloride, $SbCl_5$, $POCl_3$.

Deliquescent. (Weber.)

Antimony platinum potassium chloride, $(Sb, Pt)Cl_6K_2$.

Ppt. (Weinland, B. 1905, **38.** 1086.)

Antimony potassium chloride, $SbCl_3$, $2KCl$.

Sol. in H_2O without decomp. (Jacquelain, A. ch. (2) **66.** 128.)

Not deliquescent. Immediately decomp. by hot or cold H_2O. Sol. in HCl, or tartaric acid+Aq. (Benedikt, Proc. Am. Acad. **29.** 219.)

$+2H_2O$. Very efflorescent.

$SbCl_3$, $3KCl$. Deliquescent. Decomp. by hot H_2O. (Poggiale.)

$+2H_2O$. (Romanis, C. N. **49.** 273.)

Not obtained by Benedikt (*l.c.*)

$10SbCl_3$, $23KCl$. True composition of above salts. Sol. in H_2O. (Herty, Am. Ch. J. 1894, **16.** 495.)

$SbCl_3$, $2KCl$ is the only true compound, all

others being isomorphous mixtures. (Jordis, B. 1903, **36.** 2539.)

$2SbCl_4$, $3KCl$. Deliquescent. Decomp. by H_2O. (Bosek, Chem. Soc. 1895, **67.** 516.)

$SbCl_6KSbCl_5KOH$. Hydroscopic. Sol. in H_2O with decomp. (Weinland, B. 1901, **34.** 2635.)

See also **Antimony antimonyl potassium chloride.**

Antimony rubidium chloride, $SbCl_3$, $RbCl$.

Decomp. on air or with H_2O. (Saunders, Am. Ch. J. **14.** 162.)

$2SbCl_3,RbCl+H_2O$. Decomp. on air. (Wheeler, Z. anorg. **5.** 253.)

$SbCl_3$, $6RbCl$. Decomp. by H_2O. (Godeffroy, Arch. Pharm. (3) **9.** 343.)

Formula is $10SbCl_3$, $23RbCl$ (?). (Saunders Am. Ch. J. **14.** 159.)

$10SbCl_3$, $23RbCl$ (?). Decomp. by H_2O; sol. in HCl+Aq. (Saunders.)

Formula is $3SbCl_3,7RbCl$. (Wells and Foote, Am. J. Sci. 1897, (4) **3.** 461.)

Composition assigned to this salt by Saunders (Am. Ch. J. **14.** 155) is incorrect. (Ephraim, B. 1903, **36.** 1817.)

$3SbCl_3$, $5RbCl$. As above. (Saunders.)

Formula is $2SbCl_3$, $3RbCl$. (Wheeler.)

Rb_2SbCl_6. Ppt. Decomp. by H_2O. (Weinland, B. 1905, **38.** 1083.)

Rb_2SbCl_6, $2Rb_3SbCl_6$. Ppt. Decomp. by H_2O. (Weinland, B, 1901, **34.** 2635.)

Antimony selenium chloride, $SbCl_5$, $SeCl_4$.

Deliquescent. (Weber.)

Antimony selenyl chloride, $SbCl_5$, $SeOCl_2$.

Very deliquescent. (Weber, Pogg. **125.** 325.)

Antimony sodium chloride, $SbCl_3$, $3NaCl$ (?).

Decomp. by much H_2O. (Poggiale.)

Antimony sulphur chloride, $2SbCl_5$, $3SCl_2$.

Decomp. by H_2O.

$SbCl_5$, SCl_4. Sol. in dil. HNO_3+Aq. Mpt. 125–126° in an atmos. of chlorine. Violently decomp. by H_2O. (Ruff, B. 1904, **37.** 4515.)

Antimony thallium chloride, $SbCl_3$, $3TlCl$.

Ppt. (Ephraim, Z. anorg. 1909, **61.** 249.)

$SbCl_4$, $TlCl$. (Ephraim and Barteczko, Z. anorg. 1909, **61.** 251.)

$2SbCl_4$, $2TlCl$, $TlCl_3$. Slowly decomp. by cold H_2O. (Ephraim and Barteczko, Z. anorg. 1909, **61.** 253.)

Antimony *tri*chloride ammonia, $SbCl_3$, NH_3.

Not very deliquescent. Decomp. by H_2O.

Antimony *penta*chloride ammonia, $SbCl_5$, $6NH_3$.

Decomp. by H_2O. (Persoz.)

Antimony *penta*chloride cyanhydric acid, $SbCl_5$, $3HCN$.

Deliquescent; decomp. by H_2O. (Klein, A. **74.** 85.)

Antimony *penta*chloride nitric oxide, $2SbCl_5$, NO.

Decomp. by H_2O. (Besson, C. R. **108.** 1012.)

Antimony *penta*chloride nitrogen *per*oxide, $3SbCl_5$, $2NO_2$.

Decomp. by H_2O. (Besson.)

Antimony *penta*chloride nitrogen sulphide, $SbCl_5$, N_4S_4.

Easily decomp. (Davis, Chem. Soc. 1906, **89.** 1577.)

Decomp. by cold H_2O, HCl, H_2SO_4 and warm alcohol, also by boiling with KOH+Aq. Almost insol. in organic solvents. (Wölbling, Z. anorg. 1908, **57.** 283.)

Antimony chloride potassium bromide, $SbCl_3,3KBr+1\frac{1}{2}H_2O$.

Very deliquescent. Decomp. by much H_2O. (Atkinson, Chem. Soc. **43.** 289.)

$2SbCl_3,3KBr+2H_2O$. (Atkinson.)

$SbCl_3,KBr+H_2O$. (Atkinson.)

Above are mixtures. (Herty, Am. Ch. J. 1894, **16.** 497.)

See **Antimony bromide potassium chloride.**

Antimony chlorofluoride, $SbCl_3F_2$.

(Swarts, Z. anorg. 1896, **12.** 71.)

Antimony fluoiodide, SbF_5I.

Slowly decomp. by H_2O. (Ruff, B. 1906, **39.** 4321.)

$(SbF_5)_2I$. Sol. in H_2O with pptn. of I_2. (Ruff, B. 1906, **39.** 4321.)

Antimony *tri*fluoride, SbF_3.

Deliquescent. Sol. in H_2O.

Solubility in H_2O at t°.

t°	100 g. of the solution contain g. SbF_3	100 g. H_2O contain g. SbF_3
0°	79.37	384.7
20	81.64	444.7
22.5	81.91	452.8
25	83.12	492.4
30	84.93	563.6

(Rosenheim, Z. anorg. 1909, 61. 189.)

Solubility in HF+Aq at 0°.

Normality of HF+Aq	100 g. H_2O of the HF solution dissolve g. SbF_3
2	474.9
1	432.5
0.5	404.0

(Rosenheim, Z. anorg. 1909, **61.** 192.)

Solubility of SbF_3 in salts+Aq at 0°.

Salt	Normality of salt solution	100 g. H_2O of the salt solution dissolve g. SbF_3
KCl	1	461.8
	0.5	448.3
	0.25	431.9
	0.125	407.3
KBr	1	448.7
	0.5	450.0
	0.25	455.6
	0.125	417.2
KNO_3	1	458.2
	0.5	451.9
	0.25	418.3
	0.125	401.4
½K_2SO_4	1	419.9
	0.5	408.5
	0.25	406.6
½$K_2C_2O_4$	1	465.7
	0.5	481.2
	0.25	451.3
	0.125	405.2
½$(NH_4)_2C_2O_4$	0.5	431.9
	0.25	442.3
	0.125	433.3
½$K_2C_4H_4O_6$	1	461.4
	0.5	430.5
	0.25	430.8
	0.125	435.2

(Rosenheim, Z. anorg. 1909, **61.** 192.)

Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 826.)

Antimony *penta*fluoride, SbF_5.

Sol. in H_2O. (Marignac, A. **145.** 239.)
Very hydroscopic; bpt. 155°. Sol. in H_2O with hissing. (Ruff, B. 1904, **37.** 678.)
$+2H_2O$. (Ruff, B. 1904, **37.** 679.)

Antimony *penta*fluoride *di*antimony *tri*fluoride, $Sb_3F_{11}=2SbF_3, SbF_5$.

Hydroscopic; bpt. 390°. Easily sol. in H_2O. (Ruff, B. 1904, **37.** 680.)

Antimony *penta*fluoride *penta*antimony *tri*fluoride, SbF_5, $5SbF_3$.

B pt. 384° (corr.). (Ruff, B. 1904, **37.** 681.)

Antimony cæsium fluoride,

CsF,$2SbF_3$.
CsF,$3SbF_3$.
4CsF,$7SbF_3$.
CsF,SbF_3.
2CsF,SbF_3.
(Wells, Am. J. Sci. 1901, (4) **11.** 451.)

Antimony lithium fluoride, SbF_3, 2LiF.

Sol. in more than 20 pts. H_2O. (Flückinger, Pogg. **87.** 245.)
SbF_3, LiF. Easily sol. in H_2O. (Stein, Chem. Z. **13.** 357.)

Antimony potassium fluoride, SbF_3, 2KF.

Sol. in less than 2 pts. boiling, and in 9 pts. cold H_2O. Insol. in alcohol or ether.
SbF_3, KF. More sol. than SbF_3, 2KF. Sol. in 2.8 pts. H_2O. (Flückinger, Pogg. **87.** 245.)
SbF_5, KF. Easily sol. in H_2O.
SbF_5, $2KF+2H_2O$. Easily sol. in H_2O. (Marignac, A. **145.** 239.)

Antimony sodium fluoride, SbF_3, 3NaF.

Sol. in 14 pts. cold, and 4 pts. boiling H_2O. Sol. in HF. (Flückinger, Pogg. **87.** 245.)
SbF_3, NaF. 100 pts. cold H_2O dissolve 93 pts. 100 pts. hot H_2O dissolve 166 pts. (Stein, Wagners' J. B. **1887.** 1160.)
$4SbF_3$, NaF. As NH_4 salt. (Raad and Hauser, B. 1890, **23.** R. 125.)
SbF_5, 2NaF. Easily sol. in H_2O. (Marignac, A. **145.** 329.)

Antimony thallium fluoride, TlF,SbF_3.

Sol. in H_2O without decomp. (Ephraim, B. 1909, **42.** 4458.)
TlF,$2SbF_3$. Sol. in H_2O without decomp. (Ephraim.)
TlF,$3SbF_3$. Sol. in H_2O without decomp. Decomp. by cold conc. H_2SO_4. (Ephraim.)

Antimony *tri*fluoride ammonia, SbF_3, $2NH_3$.

Sl. sol. in liquid NH_3. (Ruff, B. 1906, **39.** 4326.)

Antimony *tri*fluoride ammonium chloride. SbF_3, NH_4Cl.

Easily sol. in H_2O. (de Haen, B. **21.** 901 R.)

Antimony *tri*fluoride ammonium sulphate, SbF_3, $(NH_4)_2SO_4$.

More sol. than K or Na salt. 1 pt. H_2O dissolves 1.4 pts. at 24° and 15 pts. at 100°. (de Haen, B. **21.** 902 R.)

Antimony fluoride lithium chloride, SbF_3, LiCl.

Sol. in H_2O. (Stein, Chem. Z. **13.** 357.)

Antimony *penta*fluoride nitrosyl fluoride, SbF_5, NOF.

Hydroscopic. Decomp. by H_2O. Sol. in liquid NH_3 with decomp. Sl. sol. in NOCl, $SiCl_4$, PCl_3, $AsCl_3$, SO_2Cl_2 and $SOCl_2$. (Ruff, Z. anorg. 1908, **58.** 334.)

Antimony *tri*fluoride potassium chloride, SbF_3, KCl.

100 pts. H_2O dissolve 51 pts. at 24°, and 300 pts. at 100°. (de Haen, B. **21.** 901 R.)

Antimony *tri*fluoride potassium sulphate, SbF_3, K_2SO_4.

Sol. in H_2O. (de Haen.)

$2SbF_3$, K_2SO_4. Very sol. in H_2O. (Mayer, B. 1894, **27**. R. 922.)

Antimony *tri*fluoride sodium chloride, SbF_3, NaCl.

Easily sol. in H_2O. (de Haen, B. **21**. 901 R.)

Antimony *tri*fluoride sodium sulphate, SbF_3, Na_2SO_4.

Sol. in H_2O. (de Haen.)

Antimony fluoiodide, SbF_5I.

Mpt. 80°; slowly decomp. by H_2O. (Ruff, B. 1906, **39**. 4321.)

$(SbF_5)_2I$. Mpt. 110–115°; decomp. by H_2O. (Ruff.)

Antimony fluosulphide, SbF_5S.

Very hygroscopic. Decomp. by H_2O. Sol. with decomp. in alcohol. Sol. in CCl_4. (Ruff, B. 1906, **39**. 4322.)

Antimony gold, Au_3Sb.

Insol. in equal pts. of HNO_3 and tartaric acids. (Roessler, Z. anorg. 1895, **9**. 72.)

Antimony hydride, SbH_3.

Scarcely sol. in H_2O. 1000 ccm. H_2O absorb 4.12 cc. SbH_3 at 10.5°. Decomp. by long contact with H_2O; also by conc. H_2SO_4 or KOH+Aq. (Jones, Chem. Soc. **29**. 641.)

Antimony *tri*hydroxide, Sb_2O_3, $2H_2O = Sb_2O(OH)_4$.

(Schaffner, A. **51**. 182.)

$Sb(OH)_3$. Ppt. (Clarke and Stolla, B. **13**. 1787.)

Does not exist. (Guntz, C. R. **102**. 1472.)

See **Antimonous acid** *and* **antimony *tri*oxide.**

Antimony *tri*iodide, SbI_3.

Decomp. by H_2O or 80% alcohol. Sol. in HI+Aq; sol. in boiling CS_2, and in boiling benzene, but separates out on cooling. Almost insol. in $CHCl_3$. (Cooke, Proc. Am. Acad. (2) **5**. 72.)

Easily sol. in $AsBr_3$. (Walden, Z. anorg. 1902, **29**. 374.)

Sol. in warm $AsBr_3$. Sp. gr. of a solution sat. at 40°, which solidifies at 37°, =3.720. This dissolves further AsI_3, whereby the mpt. sinks to 31° and sp. gr. rises to 3.801. By mixing the latter solution with a solution of AsI_3 in CH_2I_2, a liquid can be obtained with a sp. gr. of 3.702 at 20°. (Retgers, Z. phys. Ch. 1893, **11**. 340.)

Sol. in PCl_3. (Beckmann, Z. anorg. 1906, **51**. 110.)

Sol. in SO_2Cl_2. (Walden, Z. anorg. 1900, **25**. 215.)

Sol. in $SOCl_2$ and S_2Cl_2. (Walden, Z. anorg. 1900, **25**. 216.)

Sol. in $AsCl_3$. (Walden, Z. anorg. 1900, **25**. 214.)

Sol. in $SnCl_4$. (Walden, Z. anorg. 1900, **25**. 218.)

Sol. in $POCl_3$. (Walden, Z. anorg. 1900, **25**. 212.)

Easily sol. in PCl_3 and PBr_3. (Walden, Z. anorg. 1900, **25**. 211.)

Partly sol. in, and partly decomp. by alcohol or ether. (M'Ivor, Chem. Soc. (2) **14**, 328.)

Insol. in oil of turpentine and CCl_4.

100 pts. methylene iodide dissolve 11.3 pts. SbI_3 at 12°; sp. gr. of solution=3.453. (Retgers, Z. anorg. **3**. 343.)

Sol. in C_6H_6. (Retgers, Z. phys. Ch. 1893, **11**. 334.)

Sol. in acetone. (Naumann, B. 1904, **37**. 4328.)

Antimony *penta*iodide, SbI_5.

Very unstable. (Pendleton, C. N. **48**. 97.)

Antimony barium iodide, SbI_3, BaI_2+9H_2O.

Decomp. by H_2O. Sol. in HCl, $HC_2H_3O_2$, or $H_2C_4H_4O_6$+Aq. CS_2 dissolves out SbI_3. (Schäffer, Pogg. **109**. 611.)

Antimony cæsium iodide, $2SbI_3,3CsI$.

Sl. sol. in HI+Aq. Exists in two distinct forms. (Wells, Am. J. Sci. 1901, (4) **11**. 455.)

Antimony potassium iodide, $2SbI_3$, $3KI+3H_2O$.

Decomp. by H_2O. Sol. in HCl, $HC_2H_3O_2$, or $H_2C_4H_4O_6$+Aq. CS_2 dissolves out SbI_3. (Schäffer, Pogg. **109**. 611.)

SbI_3, $2KI+2\frac{1}{2}H_2O$. Decomp. by H_2O. (Nicklès, J. Pharm. (3) **39**. 116.)

Antimony rubidium iodide, $2SbI_3$, 3RbI.

Decomp. by H_2O. (Wheeler, Z. anorg. **5**. 259.)

Antimony sodium iodide, $2SbI_3$, $3NaI+12H_2O$.

As $2SbI_3$, 3KI. (Schäffer, Pogg. **109**. 611.)

Antimony thallous iodide, $2SbI_3$, 3TlI.

Decomp. by H_2O and by HCl+Aq, also by alcohol. (Ephraim, Z. anorg. 1908, **58**. 354.)

Antimony nitride, SbN.

Decomp. by heat. (Franz Fischer, B. 1910, **43**. 1471.)

Antimony *tri*oxide, Sb_2O_3.

Very sl. sol. in H_2O. Sol. in 8900–10,000 pts. H_2O at 100°; 55,000–61,100 pts. at 15°. (Schulze, J. pr. (2) **27**. 320.)

Sol. in HCl+Aq. Insol. in HNO_3+Aq, but not as insol. as metastannic acid. Sol. in cold fuming HNO_3 or H_2SO_4. Insol. in dil., but sol. in conc. alkalies, or alkali carbonates+

Aq. Sol. in cold NH_4Cl, or NH_4NO_3+Aq. Sol. in 15 pts. boiling $SbCl_3$. (Schneider, Pogg. **108.** 407.)

Sol. in $HC_2H_3O_2$, or $H_2C_4H_4O_6$+Aq, and not pptd. from these solutions by H_2O. Easily sol. in benzoic acid. Insol. in pyrotartaric acid. Very sol. in $KHC_4H_4O_6$+Aq. Sol. in glycerine.

Somewhat sol. in H_3PO_4+Aq. (Köhler, Dingl. 1885, **258.** 520.)

Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 826.)

Sol. in lactic acid. (Kretzschmar, Ch. Z. 1888, **12.** 943.)

Sol. in grape sugar solution to which $Ca(OH)_2$ has been added. (Vogel, B. 1885, **18,** R. 38.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329; Eidmann, C. C. **1899,** II. 1014.)

Sol. in glycerine in presence of alkalies. (Köhler, Dingl. 1885, **258.** 520.)

Exists in a sol. colloidal modification. (Spring, B. **16.** 1142.)

Min. *Valentinite, Senarmontite.*

$+H_2O$. *See* **Antimonous acid.**

Antimony *tetr*oxide, Sb_2O_4.

Insol. in H_2O. Slightly attacked by acids; hot conc. HCl+Aq acts only slightly. (Fresenius.)

Min. *Cervantite.* Sl. sol. in HCl+Aq.

Antimony *pent*oxide, Sb_2O_5.

Insol. in H_2O. Easily sol. in HCl+Aq. Sl. sol. in conc. KOH+Aq.

"Antimonoxyd" is sol. in glycerine in presence of alkalies.

100 g. glycerine, to which have been added 10 g. NaOH+Aq (1 : 1), dissolve 20.6 g. at b.-pt.; 20 g. NaOH+Aq (1 : 1), dissolve 36.0 g. at b.-pt.; 40 g. NaOH+Aq (1 : 1), dissolve 68.5 g. at b.-pt.; 80 g. NaOH+Aq (1 : 1), dissolve 93.0 g. at b.-pt.; 120 g. NaOH +Aq (1 : 1), dissolve 119.2 g. at b.-pt. (Köhler, Dingl. **258.** 520.)

See also **Antimonic acid.**

Antimony nitrogen *pent*oxide, $2Sb_2O_5$, N_2O_5.

Not decomp. by H_2O. (Thomas, C. R. 1895, **120.** 1116.)

Antimony oxybromide.

See **Antimonyl bromide.**

Antimony oxychloride.

See **Antimonyl chloride.**

Antimony oxyfluoride.

See **Antimonyl fluoride.**

Antimony oxysulphide, Sb_2OS_2.

Min. *Antimony blende* (*kermesite*).

Insol. in H_2O or dil. acids, except HCl+Aq. (Schneider, Pogg. **110.** 147.)

Antimony palladium, Sb_2Pd.

Sl. sol. in equal pts. of HNO_3 and tartaric acids. (Roessler, Z. anorg. 1895, **9.** 69.)

Antimony platinum, Sb_2Pt.

Insol. in equal pts. of HNO_3 and tartaric acids. (Roessler, Z. anorg. 1895, **9.** 67.)

Antimony phosphide, SbP.

Insol. in benzene, ether, or CS_2. (M'Ivor, B. **6.** 1362.)

Antimony selenide, SbSe.

(Chrétien, C. R. 1906, **142.** 1341.)

Sb_3Se_4. (Chrétien, *l.c.*)

Sb_4Se_5. (Chrétien, *l.c.*)

Sb_2Se_3. Sol. in KOH+Aq. (Hofacker, A. **107.** 6.)

Sb_2Se_5. (Hofacker.)

Antimony selenide, *with* M selenide.

See **Selenoantimonates, M.**

Antimony *tri*sulphide, Sb_2S_3 (*Kermes*).

Insol. in H_2O and dil. acids.

1 l. H_2O dissolves 5.2 x 10^{-6} mols. pptd. Sb_2S_3 at 18°. (Weigel, Z. phys. Ch. 1907, **58.** 294.)

Decomp. by conc. HNO_3 or H_2SO_4. Sol. in conc. HCl+Aq. Easily sol. in dil. KOH, NaOH, $(NH_4)_2S$, and K_2S+Aq. Sl. sol. in NH_4OH+Aq; very sl. sol. in $(NH_4)_2CO_3$+Aq; insol. in KSH+Aq. (Fresenius.)

Sol. in a mixture of 50 pts. H_2O and 18 pts. HCl (sp. gr. 1.16) even when completely sat. with H_2S. (Lang and Carson, J. Soc. Chem. Ind. 1902, **21.** 1018.)

Sl. sol. in H_2SO_3+Aq. (Guerout, C. R. 1872, **75.** 1276.)

Cryst. Sb_2S_3 is only sl. sol. in NH_4OH+Aq (1 pt. in about 2000 pts. NH_3).

Pptd. amorphous Sb_2S_3 is appreciably more sol. (1 pt. in 600 pts. NH_3). (Garot, J. pr. 1843, **29.** 83.)

Sl. sol. in hot 2% $Na_2B_4O_7$+Aq, still less sol. in cold. (Materne, C. C. **1906,** II. 557.)

Insol. in NH_4Cl+Aq.

Sol. in 14–15 pts. pure $SbCl_3$. (Schneider, Pogg. **108.** 407.)

Slowly sol. in $H_2C_4H_4O_6$+Aq.

Sol. in boiling Na_3SbS_4+Aq.

Sol. in hot citric, tartaric and oxalic acids. Sl. sol. in malic, benzoic, picric and pyrogallic acids. Insol. in formic and acetic acids. Especially easily sol. in citric and oxalic acids with addition of KNO_3, KNO_2 or $KClO_3$. (Bolton, C. N. 1878, **37.** 86 and 99.)

Sol. in ethylamine sulphydrate+Aq.

Min. *Stibnite.* Sol. in cold citric acid+Aq. (Bolton, C. N. **37.** 14.)

Soluble modification. Sb_2S_3 may be obtained in a colloidal state in aqueous solution containing 1 pt. Sb_2S_3 to 200 pts. H_2O. This can be boiled without decomp., but Sb_2S_3 is pptd. by acids and salts.

Table of maximum dilution of solutions of acids and salts which cause pptn. of Sb_2S_3.

HCl	1 : 270
H_2SO_4	1 : 140
$H_2C_2O_4$	1 : 45
K_2SO_4	1 : 65
$(NH_4)_2SO_4$	1 : 130
$MgSO_4$	1 : 1720
$MnSO_4$	1 : 2060
NaCl	1 : 135
$BaCl_2$	1 : 2050
$MgCl_2$	1 : 5800
$CoCl_2$	1 : 2500
KNO_3	1 : 75
Fe_2Cl_6	1 : 2500
$Ba(NO_3)_2$	1 : 1250
$K_2Al_2(SO_4)_4$	1 : 35,000
$(NH_4)_2Fe_2(SO_4)_4$	1 : 800
$K_2Cr_2(SO_4)_4$	1 : 40,000
$KSbOC_4H_4O_6$	1 : 18

(Schulze, J. pr. (2) **27.** 320.)

Antimony *tri*sulphide with **M_2S.**

See **Sulphantimonites, M.**

Antimony *penta*sulphide, Sb_2S_5.

Insol. in H_2O, or H_2O containing H_2S. Sol. in conc. HCl+Aq. Completely sol. in NH_4OH+Aq; traces dissolve in $(NH_4)_2CO_3$+Aq. Easily sol. in KOH, or NaOH+Aq, or in alkali sulphides+Aq. Sol. in 50 pts. cold dil. NH_4OH+Aq. (Geiger.)

Insol. in $(NH_4)_2CO_3$+Aq.

Insol. in cold, but sol. in hot alkali carbonates+Aq. (Berzelius.)

Insol. in Na_3SbS_4+Aq.

When boiled with alcohol, ether, CS_2, oil of turpentine, etc., portion of the S is dissolved out. (Berzelius.)

CS_2 dissolves about 5% of the sulphur. (Rammelsberg.)

Antimony *penta*sulphide with M_2S.

See **Sulphantimonates, M.**

Antimony sulphochloride, $SbSCl_3$.

Decomp. by moist air or H_2O. (Cloez, A. ch. (3) **30.** 374.)

SbS_2Cl. Easily attacked by acids; insol. in CS_2. (Ouvrard, C. R. **116.** 1516.)

Sb_2S_5Cl. (Ouvrard.)

$2SbSCl, 3Sb_2S_3$. Decomp. by dil. HCl+Aq. (Schneider.)

$SbSCl, 7SbCl_3$. Deliquescent; decomp. by H_2O. (Schneider, Pogg. **108.** 407.)

Antimony sulphofluoride, SbF_5S.

See **Antimony fluosulphide.**

Antimony sulphoiodide, SbSI.

Not attacked by H_2O, and decomp. only by conc. acids. Insol. in CS_2. (Schneider, Pogg. **110.** 147.)

$Sb_2S_3I_6$. (Henry and Garot.)

$Sb_2S_2I_3$. Sol. in dry CS_2. Very easily decomp. (Ouvrard, C. R. **117.** 108.)

Antimony sulphur *di*oxide, $SbSO_2$.

Ppt. (Faktor, C. C. **1900,** I. 1211.)

Antimony telluride, SbTe.

Insol. in H_2O.

Sb_2Te_3. Insol. in H_2O. (Oppenheim, J. pr. **71.** 277.)

Antimonyl bromide, SbOBr.

Insol. in CS_2. (Cooke, Proc. Am. Acad. **13.** 104.)

Sl. sol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 826.)

$Sb_4O_5Br_2$. (M'Ivor, C. N. **29.** 179.)

$10Sb_4O_5Br_2, SbBr_3$.

Antimonyl chloride.

From $SbCl_3$. SbOCl. Insol. in H_2O. Decomp. by boiling with H_2O; sol. in HCl+Aq. Insol. in alcohol or ether; sol. in CS_2, $CHCl_3$, or C_6H_6. (Sabanajew, Zeit. Ch. **1871.** 204.)

Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 826.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329.)

$Sb_4O_5Cl_2$. *Algaroth powder*. Decomp. by H_2O. Sol. in HCl+Aq (Cooke, Proc. Am. Acad. **13.** 1); tartaric acid+Aq. (Schäffer, A. **152.** 135.)

$Sb_8O_{11}Cl_2$. (Cooke.)

Sb_8OCl_{22}.

$Sb_{41}O_{50}Cl_{23}$.

From $SbCl_5$. $SbOCl_3$. Deliquescent. Decomposed by H_2O. Sol. in H_2O. (Daubrawa, A. **184.** 118.)

Does not exist. (Anschütz and Evans, A. **239.** 285.)

Sb_3OCl_{13}. Deliquescent. Insol. in CS_2; easily sol. in tartaric acid+Aq. (Williams, C. N. **24.** 224.)

$Sb_3O_4Cl_7$. (Williams.)

SbO_2Cl. Decomp. by hot H_2O into $HSbO_3$.

Antimonyl fluoride.

From SbF_3. $Sb_4O_3F_6$. Not deliquescent. (Flückiger, Pogg. **87.** 249.)

Antimonyl cæsium fluoride, SbF_4OH, CsF.

(Wells, Am. J. Sci. 1901, (4) **11.** 456.)

Antimonyl sodium fluoride, $SbOF_3, NaF+H_2O$.

Deliquescent. Easily sol. in H_2O. (Marignac, A. **145.** 239.)

Antimonyl iodide, $Sb_4O_5I_2$.

Difficultly sol. in solution of tartaric acid or tartrates. Decomp. by HCl, HNO_3, or H_2SO_4+Aq. Easily sol. in alkalies, or $(NH_4)_2S$+Aq.

SbOI. Insol. in CS_2. (Cooke, Proc. Am. Acad. (2) **5.** 72.)

Antimonyl sulphide.

See **Antimony oxysulphide.**

Argon, A.

100 cc. H_2O dissolve 4.05 cc. argon at 13.9°. Critical t.—121.6° under 50.6 atmos. Bpt. —186.9°. Sp. gr. 19.9. (Rayleigh, C. N. 1895, **71.** 51–62; 299–302; C. C. **1895.** 467.)

Coefficient of absorption in H_2O at 12° = 0.0394; at 13.9° = 0.0405. (Ramsay, Phil. Trans. 1895, **186.** A. 225.)

Absorption by H_2O at t°.

t°	Coefficient of absorption
0°	0.0561
10	0.0438
20	0.0379
30	0.0348
40	0.0338
50	0.0343

(Antropoff, Roy. Soc. Proc. 1910, **83.** A. 480.)

Absorption of argon by H_2O at t° and 760 mm. pressure.

t°	Coefficient of absorption
0°	0.05780
1	0.05612
5	0.05080
10	0.04525
15	0.04099
20	0.03790
25	0.03470
30	0.03256
35	0.03053
40	0.02865
45	0.02731
50	0.02567

(Estreicher, Z. phys. Ch. 1899, **31.** 184.)

1 l. H_2O at 38° absorbs 25.7 cc. A.

1 l. blood absorbs 25.3 cc. A. (Regnard and Schloesing, C. R. 1897, **124.** 303.)

Not absorbed by members of the fatty series of organic compounds; with members of the aromatic series absorption was observed varying from 8% of the volume employed for benzene to 1% for aniline. (Berthelot, C. R. 1899, **129.** 71.)

Arsenamide, $As(NH_2)_3$.

Insol. in liquid NH_3. Decomp. by H_2O. (Hugot, C. R. 1904, **139.** 55.)

Arsenic, As.

Unaltered by pure H_2O. Insol. in HCl+Aq if air is excluded, but sl. sol. in presence of air. Not attacked by dil. H_2SO_4+Aq. Oxidized by conc. H_2SO_4, HNO_3, or aqua regia. Not attacked at 20° by HNO_3, conc. or dil., or containing NO_2; nor by HNO_3+HCl, as long as they do not act on each other; but if treated with the above mixture in extremely dilute state, and a few drops of KNO_2+Aq are added, the As is attacked at once. (Millon, A. ch. (3) **6.** 101.)

Sol. in sea water; 0.009 mg. per liter off Brittany; 0.01 to 0.09 mg. per liter near Azores. (Gautier, C. R. 1903, **137.** 232.)

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 827.)

Insol. in liquid NH_3. (Hugot, A. ch. 1900, (7) **21.** 31.)

Insol. in NaOH, KOH, or NH_4OH+Aq.

Sol. in S_2Br_2. (Hannay, Chem. Soc. (2) **11.** 823.)

Insol. in alcohol and ether.

Sol. in certain fatty oils.

Insol. in methylene iodide. (Retgers, Z. anorg. **3.** 343.)

½ ccm. oleic acid dissolves 0.0032 g. As in 6 days. (Gates, J. phys. Ch. 1911, **15.** 143.)

Yellow modification. Very unstable. (McLeod, C. N. 1894, **70.** 139.)

Fairly stable in liquid air. (Thomson, Chem. Soc. 1906, **90.** (2) 745.)

100 ccm. CS_2 dissolve at:

46°	20°	12°	0°	—15°	—60°
11	8	6	4	2.0–2.5	1.0 g. As.

Less sol. in benzene and ethyl acetate. (Erdmann, Z. anorg. 1902, **32.** 448.)

Arsenic acid. *See* page 59.

Arsenic bromide, $AsBr_3$.

Decomp. by H_2O. Completely sol. in about 3 pts. boiling H_2O, and much less, in presence of HBr. (Wallace, Phil. Mag. (4) **17.** 261.)

Sol. in CS_2.

Sol. in $AlBr_3$. (Isbekow, Z. anorg. 1913, **84.** 26.)

Easily sol. in PCl_3 and PBr_3. (Walden, Z. anorg. 1900, **25.** 211.)

Sol. in S_2Cl_2. (Walden, Z. anorg. 1900, **25.** 217.)

Arsenic cæsium bromide, $2AsBr_3$, 3CsBr.

Decomp. by H_2O; can be recryst. from conc. HBr+Aq. (Wheeler, Z. anorg. **4.** 451.)

Arsenic rubidium bromide, $2AsBr_3$, 3RbCl.

As the corresponding Cs comp.

Arsenic bromide ammonia, $AsBr_3$, $3NH_3$.

Decomp. by H_2O. (Besson, C. R. **110.** 1258.)

Arsenic bromide copper, $2AsBr_3$,7Cu.

Stable toward hot H_2O. Decomp. by KOH. (Hilpert and Herrman, B. 1913, **46.** 2224.)

Arsenic bromide silver, $AsBr_3$, 3Ag.

Scarcely decomp. by cold H_2O. (Hilpert and Herrmann.)

Arsenic chloride, $AsCl_3$.

Miscible with little H_2O, and with alcohol, ether, and volatile oils. Decomp. by much H_2O, or by boiling. (Gmelin.)

Miscible with oil of turpentine, and with olive oil. Somewhat sol. in HCl+Aq.
Easily sol. in PCl_3 and PBr_3. (Walden, Z. anorg. 1900, **25.** 211.)
Sol. in liquid CN. (Centnerszwer, J. russ. phys. Ges. 1901, **33.** 545.)
Sol. in S_2Cl_2. (Walden, Z. anorg. 1900, **25.** 217.)

Arsenic *penta*chloride, $AsCl_5$.

Fumes in the air with evolution of hydrogen chloride. Readily sol. in CS_2, and absolute ether cooled to —30°. (Baskerville, J. Am. Chem. Soc. 1902, **24.** 1070.)

Arsenic cæsium chloride, $2AsCl_3$, $3CsCl$.

Decomp. by H_2O. 100 pts. HCl+Aq (1.2 sp. gr.) dissolve 0.429 pt. salt. (Wheeler, Z. anorg. **4.** 451.)

Arsenic iridium phosphorus chloride.

See **Iridium phosphorus chloride arsenic chloride.**

Arsenic rubidium chloride, $2AsCl_3$, $3RbCl$.

Decomp. by H_2O. 100 pts. HCl+Aq (sp. gr. 1.2) dissolve 2.935 pts. salt. (Wheeler, Z. anorg. **4.** 451.)

Arsenic sulphur chloride, $2AsCl_3$, $3SCl_2$.

Decomp. by H_2O. (Rose.)
Above compound is a mixture. (Nilson, C. N. **81.** 81.)

Arsenic chloride ammonia, $2AsCl_3$, $7NH_3$.

Decomp. by cold H_2O, with evolution of NH_3. From the solution crystallizes $As_4Cl_2N_2H_{10}O_8$.
Sol. in alcohol without decomp. (Rose, Pogg. **52.** 62.)
Composition is $AsCl_3$, $4NH_3$. (Besson, C. R. **110.** 1258.)

Arsenic chloride copper, $2AsCl_3$,$7Cu$.

Somewhat decomp. by H_2O. Decomp. by KOH, or hot HCl. (Hilpert and Herrman, B. 1913, **46.** 2224.)

Arsenic chloride silver, $2AsCl_3$, $7Ag$.

H_2O, NH_4OH and KOH split off Ag. (Hilpert and Herrmann.)

Arsenic *tri*fluoride, AsF_3.

Sol. in H_2O with evolution of heat and decomposition. (Berzelius.)
Easily sol. in benzene. (Moissan, C. R. **99.** 874.)
Miscible with alcohol and ether. (M'Ivor, C. N. **30.** 169.)

Arsenic *penta*fluoride, AsF_5.

Sol. in H_2O, alkalies+Aq and liquid AsF_3 with evolution of heat. Absorbed by ether, alcohol and benzene with evolution of heat. (Ruff, B. 1906, **39.** 67.)

Arsenic potassium fluoride, AsF_5, KF+$\frac{1}{2}H_2O$.

AsF_5, $2KF$+H_2O.
AsF_5, $AsOF_3$, $4KF$+$3H_2O$. (Marignac, A. **145.** 237.)

Arsenic fluoride ammonia, $2AsF_3$, $5NH_3$.

Easily decomp. by H_2O. (Besson, C. R. **110.** 1258.)

Arsenic *penta*fluoride nitrosyl fluoride, AsF_5, NOF.

Decomp. by H_2O, fuming HCl, NaOH+Aq, dry ether and dry alcohol with evolution of NO. Sol. in conc. HNO_3, hot conc. H_2SO_4, boiling NOCl and AsF_3. Insol. in CCl_4 and CS_2. (Ruff, Z. anorg. 1908, **58.** 327.)

Arsenic *tri*fluoride sulphur *tetra*chloride, $2AsF_3$, SCl_4.

Very hydroscopic. Decomp. by H_2O and NaOH. Decomp. by thionyl chloride, CCl_4, CS_2, abs. alcohol and ether. Decomp. by ligroin, benzene and toluene. (Ruff, B. 1904, **37.** 4520.)

Arsenic hydride, AsH_3.

Sl. sol. in H_2O and alkali hydrates+Aq, with subsequent decomposition. H_2O absorbs $^1/_5$ vol. AsH_3. Decomp. by conc. acids. Absorbed rapidly by oil of turpentine, slightly by fixed oils, and not at all by alcohol, ether, or KOH+Aq. (Gmelin.)
Insol. in KOH+Alcohol. (Meissner.)
Not more sol. in alkaline solutions than in pure H_2O. (Berzelius.)
AsH. *Solid.* Insol. in H_2O, alcohol, ether, and CS_2. (Wiederhold, Pogg. **118.** 615.)
Insol. in H_2O; sol. in methylene iodide, xylene, or in conc. KOH+Aq. (Retgers, Z. anorg. **4.** 403.)

Arsenic hydride boron bromide, AsH_3, BBr_3.

Easily decomp. Decomp. by H_2O. Appreciably sol. in AsH_3 or BBr_3. Insol. in CS_2. (Stock, B. 1901, **34.** 949.)

Arsenic *di*iodide, As_2I_4.

Decomp. by H_2O or alkalies; easily sol. in alcohol, ether, chloroform, or carbon disulphide. (Bamberger and Phillip, B. **14.** 2643.)
Not attacked by cold conc. H_2SO_4 or by cold fuming HNO_3. The latter oxidizes on warming. Decomp. by pyridine. Sol. in boiling acetic anhydride. (Hewitt and Winmill, Chem. Soc. 1907, **91.** 962.)

Arsenic *tri*iodide, AsI_3.

Sol. in 3.32 pts. boiling H_2O, and solution if boiled down deposits pure AsI_3, but if left to cool slowly, deposits crystals of As_2O_3 and AsOI.
Sl. sol. in HCl+Aq.
Sol. in $POCl_3$, PCl_3 and PBr_3. (Walden, Z. anorg. 1900, **25.** 212.)

Sol. in PCl_3. (Beckmann, Z. anorg. 1906, **51.** 110.)

Sol. in $SOCl_2$, S_2Cl_2 and SO_2Cl_2. (Walden, Z. anorg. 1900, **25.** 216.)

Sol. in $SnCl_4$. (Walden, *l.c.*)

Easily sol. in $AsBr_3$. (Walden, Z. anorg. 1902, **29.** 374.)

Sol. in $AsCl_3$. (Walden, Z. anorg. 1900, **25.** 214.)

Sol. in alcohol without decomp.

Sol. in ether, benzene, chloroform, and CS_2.

100 pts. methylene iodide dissolve 17.4 pts. AsI_3 at 12°. (Retgers, Z. anorg. **3.** 343.)

Arsenic *penta*iodide, AsI_5.

More or less sol. in H_2O, alcohol, $CHCl_3$, ether and CS_2. (Sloan, C. N. 1882, **46.** 194.)

Arsenic cæsium iodide, $2AsI_3$, $3CsI$.

Decomp. by H_2O; sol. in conc. HI+Aq. (Wheeler, Z. anorg. **4.** 451.)

Arsenic rubidium iodide, $2AsI_3$, $3RbI$.

As the corresponding Cs comp.

Arsenic sulphur iodide.

See **Arsenic sulphoiodide.**

Arsenic *tri*iodide ammonia, $2AsI_3$, $9NH_3$.

Insol. in benzene. (Bamberger and Phillip, B. **14.** 2643.)

AsI_3, $4NH_3$. (Besson, C. R. **110.** 1258.)

Arsenic nitride, AsN.

Easily decomp. into As and N. (Hugot, C. R. 1904, **139.** 56.)

Decomp. by heat. (Franz Fischer, B. 1910, **43.** 1471.)

Arsenic *sub*oxide, As_2O (?).

Insol. in H_2O; decomp. by dil. acids or NH_4OH+Aq.

Does not exist. (Geuther, A. **240.** 208.)

Arsenic *tri*oxide, As_2O_3.

"White arsenic" exists in two modifications: αAs_2O_3,—crystalline, octahedral, opaque, porcelaneous, etc.; βAs_2O_3,—amorphous, vitreous, "arsenic glass."

The data concerning the solubility of As_2O_3 are very contradictory, the reasons being that (1) the solubility of the two modifications is different; (2) that the length of time necessary to effect solution differs in the two modifications; and (3) that there is a tendency of the amorphous As_2O_3 to go over into the crystalline state during the process of solution. αAs_2O_3 is also not easily moistened, especially when in a pulverulent condition, which is not the case with the β modification. (Winkler, J. pr. (2) **31.** 247.)

The older data are very unreliable, but possess a certain historical interest.

1 pt. As_2O_3 is sol. in 10.55 pts. (Wenzel); 11.34 pts. (Fischer); 11.86 pts. in ¼ hour (Klaproth); 12.2 pts. (Bucholz); 15.0 pts. (Brandt; Bergman); 16.0 pts. (Vogel); 24 pts. (Lametheriè); 40 pts. (Pörner); 64 pts. (Baumé); 80 pts. (Navier); 200 pts. (Aschof and Nasse, 1812); 640 pts. (Hagen, 1796) boiling H_2O.

1 pt. As_2O_3 is sol. in 7.72 pts. H_2O if α, or 9.33 pts. if β (Guibort); in 24 pts. H_2O if α, or 21 pts. if β (Taylor).

Sol. in 53.3 pts. H_2O at 18.75°. (Abl.)

Sol. in 30 pts. H_2O. (Nussembrock.)

After the solution in H_2O at 100° has been left standing at ordinary temperatures—

1 pt. As_2O_3 remains dissolved in 16 pts. H_2O at 16°, and 20 pts. H_2O at 7° (Bucholz); in 33 pts. H_2O at 7° (Klaproth); in 38.45 pts. H_2O after 3 days, 55 pts. H_2O after 8 days, 64.50 pts. H_2O after 2.3 weeks at 10° (Fischer); in 33.52 pts. if αAs_2O_3 was used, 55.06 pts. if βAs_2O_3 was used (Guibort); in 38 pts. if αAs_2O_3 after 6 months, 53.71 pts. if βAs_2O_3 after 48 hours (Taylor).

When an excess of pulverized As_2O_3 is left to digest for several days with cold H_2O—

1 pt. dissolves in 50 pts. (Bucholz); in 66 pts. (Fischer); in 80 pts. at 15° (Bergman); in 80 pts. if α, and 103 pts. if β (Guibort); 96 pts. at 10° (Spelman); 96 pts. at 35.5° (Hahnemann); 320 pts. H_2O at 20° (Aschof and Nasse, 1812.)

H_2O at 15.6° or below dissolves less than ¼% As_2O_3. (Dalton.)

To dissolve 1 pt. As_2O_3 in 12 pts. H_2O, it is necessary to boil an excess of As_2O_3 with H_2O; if 1 pt. As_2O_3 is boiled with 12 pts. H_2O, considerable remains undissolved; and even with 1 pt. As_2O_3 to 50–60 pts. H_2O long continued boiling is necessary to effect solution. If a clear solution saturated by long boiling with an excess of As_2O_3 is poured off and evaporated continuously to ½ its original bulk, no As_2O_3 separates out, and the solution contains 1 pt. As_2O_3 to 6 pts. H_2O. (Fischer.)

100 pts. aqueous solution of βAs_2O_3 sat. at 15° contain 0.96 pt. As_2O_3, and 9.68 pts. when sat. at 100°. (Guibort.)

If 1 pt. pulverized As_2O_3 be digested 10 days at 19–25° in 5–10 pts. H_2O, the solution contains 1 pt. As_2O_3 to 50 pts. H_2O. A solution of same strength is obtained in 25 days by digesting 1 pt. As_2O_3 in 40 pts. H_2O. If 1 pt. As_2O_3 be immersed in 80 pts. H_2O, the resulting solution contains 1 pt. As_2O_3 to 90 pts. H_2O; if in 160 pts. H_2O, 1 pt. As_2O_3 to 180 pts. H_2O; if in 240 pts. H_2O, 1 pt. As_2O_3 to 280 pts. H_2O; if in 1000 pts. H_2O, 1 pt. As_2O_3 to 1200 pts. H_2O; and even when 1 pt. As_2O_3 is digested at ordinary temperatures for several days with 16,000–100,000 pts. H_2O, a portion remains undissolved. Pulverized αAs_2O was set aside with H_2O in closed bottles for 18 years; when 1 pt. As_2O_3 was present in 1000 pts. H_2O, a perfect solution was obtained; when 1 pt. As_2O_3 in 100 pts. H_2O, 0.017% As_2O_3 was undissolved; when 1 pt. As_2O_3 in 35 pts. H_2O, 0.35% As_2O_3 was undissolved, so that the solution contained 1 pt. As_2O_3 to 54 pts. H_2O. (Gmelin.)

Porcelaneous modification (αAs_2O_3) is much more sol. in H_2O than the vitreous (βAs_2O_3). 100 pts. H_2O at ordinary temperature dissolve 0.96 pt. BAs_2O_3 and 1.25 pts. αAs_2O_3; 100 pts. boiling H_2O dissolve 9.68 pts. βAs_2O_3 and 11.47 pts. αAs_2O_3; and when the temperature of this solution has fallen to 15°, the solution from βAs_2O_3 retains 1.78 pts., and that from αAs_2O_3 retains 2.9 pts. (Berzelius [citing Guibort].)

βAs_2O_3 dissolves more quickly and abundantly than αAs_2O_3. The same amount H_2O which will take up 36–38 pts. βAs_2O_3 at 12–13° will dissolve only 12–14 pts. αAs_2O_3, or 100 pts. H_2O dissolve 4 pts. βAs_2O_3 and 1.2–1.3 pts. αAs_2O_3. By long boiling with H_2O, αAs_2O_3 is converted into βAs_2O_3, and thus acquires the solubility of the latter, so that 100 pts. boiling H_2O can take up 11 pts. As_2O_3. But at low temperature βAs_2O_3 is converted into αAs_2O_3 when in contact with H_2O, so that the solution becomes weaker after a while, and retains only the proportion of As_2O_3 corresponding to the solubility of αAs_2O_3. Comminution, which hastens the rate of solubility of αAs_2O_3 without increasing the amount dissolved, diminishes the solubility of βAs_2O_3, as this is converted into αAs_2O_3

by the friction or contact with H_2O. As_2O_3, which has been rendered opaque by NH_4OH, and that which has been crystallized from an aqueous solution, are equally sol. in H_2O. (Bussy, C. R. **24.** 774; A. **64.** 286.)

100 pts. H_2O dissolve 1.707 pts. βAs_2O_3 in 2½ years; 100 pts. boiling H_2O dissolve 11.46 pts. βAs_2O_3 in 3 hours, and 11.86 pts. in 12 hours; 10.14 pts. αAs_2O_3 in 3 hours, and 10.18 pts. in 12 hours. (Rose, Ann. Phys. (1) **36.** 494.)

A cold sat. solution which stood over excess of As_2O_3 for 10 months at 10–20° contains 1.2% As_2O_3; hot sat. solution a few days after saturation contains 2.25–2.50% As_2O_3. If trace of HCl is present, the solution contains 3.8% As_2O_3. Hot sat. solution of porcelain mod. of As_2O_3 contains 4 days after saturation 2.4% As_2O_3 at 24°; after 82 days at 14°, 1.5%; after 4 months at 12°, 1.3% As_2O_3. (Bacaloglo, J. pr. **83.** 111.)

According to later experiments, 1 pt. αAs_2O_3 dissolves in 355 pts. H_2O in 1 day at 15°, while 1 pt. βAs_2O_3 dissolves in 108 pts. H_2O under the same conditions. 1 pt. αAs_2O_3 dissolves in 46 pts. H_2O, if solution is prepared at 100°, and allowed to stand 24 hours at 15°, while 1 pt. βAs_2O_3 dissolves in 30 pts. H_2O under the same conditions. (Büchner, N. Rep. Pharm. **22.** 265.)

100 pts. H_2O dissolve pts. αAs_2O_3 and βAs_2O_3 at ordinary temperature:

Time	αAs_2O_3	βAs_2O_3
1 hour	0.023	1.589
3 hours	0.088	2.356
6 hours	0.353	3.666
12 hours	0.364	3.361
24 hours	0.956	3.306
2 days	1.627	2.629
4 days	1.814	2.429
1 week	1.673	1.763
3 weeks	1.776	1.713
2¼ years	1.712	1.707

In the solution of βAs_2O_3, octahedral crystals were deposited on the sides of the vessel after 12 hours, which continued to increase. There was no such deposit in the case of αAs_2O_3.

From the maxima in the above table, 100 pts. H_2O can dissolve 3.7 pts. βAs_2O_3 and 1.7 pts. αAs_2O_3 at ordinary temperature.

100 pts. boiling H_2O dissolve 11.46 pts. [illegible]0 pts. αAs_2O_3 in 3 hours; [illegible] and 10.176 pts. αAs_2O in [illegible]nkler, J. pr. (2) **31.** 247.)

[illegible]issolve 1.75 pts. of a third [illegible]agonal crystalline) at or[illegible]e, and 2.75 pts. at 100°. [illegible]oc. (2) **6.** 179.)

[illegible] more rapidly in HCl+Aq [illegible]ultz-Sellac, B. **4.** 109.)

While 100 ccm. H_2O dissolve 0.8507 g. βAs_2O_3 at 18.5°, 100 ccm. H_2O containing 1.3195 g. HCl dissolve 1.1513 g. βAs_2O_3; containing 6.09 g. HCl, 1.2724 g. βAs_2O_3. (Chodounsky, Listy Chemické, **13.** 114.)

100 ccm. H_2O dissolve 1.495 g. As_2O_3 at 15°. (Wood, Chem. Soc. 1908, **93.** 412.)

Solubility of crystalline As_2O_3 in H_2O.

1 l. of the sat. solution contains at:

2°	15°	25°	39.8°	bpt.
12.006	16.566	20.384	29.302	60+g. As_2O_3

(Bruner, Z. anorg. 1903, **37.** 456.)

Much more easily sol. in many acids than in H_2O. Easily sol. in fuming H_2SO_4. (Schultz-Sellac.)

100 pts. dilute H_2SO_4+Aq of various strengths dissolve at t°.

t°	Pts. βAs_2O_3	t°	Pts. βAs_2O_3	Ratios of amts. dissolved at 80° : 18.5°
80°	1.0195	18.5°	0.5422	1.88 : 1
..	1.3664	....	0.7203	1.89 : 1
..	1.1933	....	0.6522	1.84 : 1

(Chodounsky, *l.c.*)

Decomp. by HNO_3 or aqua regia into As_2O_5.

Sol. in H_3PO_4+Aq. (Bergman.)

More sol. in HCl+Aq than in H_2SO_4, or HNO_3+Aq, and still less in $HC_2H_3O_2$+Aq.

Solubility in HCl+Aq.

Conc. of HCl+Aq	Grams of As_2O_3 per 100 cc. of solution
0.46N	1.52
0.98N	1.41
2.03N	1.17
3.13N	1.11
3.81N	1.13
5.32N	2.20
6.50N	5.11
7.85N	12.28
9.17N	18.16

As the concentration of the acid increases, the solubility of the oxide decreases, a minimum being reached when the concentration of the solvent is about 3.2N. Beyond this point, an increase in the concentration of the solvent leads to a corresponding increase in the solubility. (Wood, Chem. Soc. 1908, **93.** 413.)

Insol. in liquid CO_2. (Büchner, Z. phys. Ch. 1906, **54.** 674.)

Easily sol. in cold $H_2C_2O_4$+Aq. (Bergman.)

When pulverized, it dissolves in hot $H_2C_2O_4$+Aq, but separates out on cooling.

Easily sol. in hot benzoic acid+Aq.

Sol. in tartaric acid+Aq.

Easily sol. in alkali hydrates, or carbonates +Aq.

Easily sol. in NH_4 arsenite+Aq at 70–80°, crystallizing out on cooling. (Berzelius.)
Sol. in hot $K_2C_2O_4$+Aq.
Sol. in $AsCl_3$. (Penney and Wallace.)
More sol. in $Na_2B_4O_7$+Aq than in H_2O.
Very sl. sol. in absolute alcohol. (Vogel.)

Sol. in 80 pts. highly rectified spirit. (Wenzel.)
When 1 pt. powdered As_2O_3 is digested 30 days in 10–40 pts. alcohol, a solution is formed containing 1 pt. As_2O_3 to 60 pts. alcohol; when 1 pt. As_2O_3 is digested with 60–150 pts. alcohol, a solution is formed containing 1 pt. As_2O_3 to 124–140 pts. alcohol. (Fischer.)
Sol. in 70–80 pts. alcohol. (Thompson.)

Alcohol dissolves 0.446 pt. βAs_2O_3. (Rose, A. Phys. (1) **52.** 455.)

100 pts. alcohol dissolve pts. As_2O_3:

Vol. % of alcohol	αAs_2O_3 at 15°	αAs_2O_3 at b.-pt. of alcohol	βAs_2O_3 at 15°
56	1.680	4.895	0.504
79	1.430	4.551	0.540
84	.....	.....	0.565
86	0.715	3.197	.....
88	.....	.....	0.717
100	0.025	3.402	1.060

(Girardin, J. Pharm. (3) **46.** 269.)

100 pts. absolute alcohol dissolve 0.446 pt. βAs_2O_3 in 2¼ years. (Winkler, J. pr. (2) **31.** 347.)
Nearly insol. in ether.
100 pts. ether dissolve 0.454 pt. βAs_2O_3. (Winkler.)
Ether extracts 1 mg. As_2O_3 from sat. As_2O_3+Aq for every 15 cc. ether used; less is extracted when the solution is acidified with HCl, and almost none if acidified with H_2SO_4 or $H_2C_4O_6$. (Selmi, B. **13.** 206.)
αAs_2O_3 is sol. in 50 pts. boiling nitrobenzol. βAs_2O_3 is insol. in boiling nitrobenzol. (Auerbach, Z. anorg. 1903, **37.** 353.)
βAs_2O_3 dissolves in oil of turpentine, but αAs_2O_3 is insol. therein. αAs_2O_3 is very sl. sol. in benzene or petroleum ether, but more sol. in methyl alcohol, ethyl alcohol, ether, or chloroform. (Selmi.)
100 pts. CS_2 dissolve 0.001 pt. βAs_2O_3 in 2¼ years. (Winkler.)
Sl. sol. in the fatty oils.
1000 pts. castor-oil dissolve 1.33 pts. As_2O_3 at ordinary temperature, and 9 pts. at boiling temperature. 1000 pts. other oils dissolve 0.6–0.8 pt. As_2O_3 in the cold, and about 1.7 pts. on boiling. (Berzelius.)
Insol. in chinoline or aniline. (Hoffmann, A. ch. (3) **9.** 143, 169.)
Moderately sol. in chinolin. (Beckmann and Gabel, Z. anorg. 1906, **51.** 236.)
Insol. in acetone. (Naumann, B. 1904, **37.** 4329); (Eidmann, C. C. **1899,** II. 1014.)
Sol. in amyl alcohol and is divided between it and H_2O in the constant ratio of 1 : 5.47 at 25°. (Auerbach, Z. anorg. 1903, **37.** 376.)
Min. *Arsenolite.*

Arsenic *tri*oxide *pent*oxide, $3As_2O_3, 2As_2O_5+3H_2O$.

Decomp. by H_2O. (Joly, C. R. **100.** 1221.)
$2As_2O_3, As_2O_5+H_2O$. Decomp. by H_2O. (Joly.)
$As_2O_3, As_2O_5+H_2O$. (Joly.)

Arsenic *tetr*oxide, As_2O_4.

Sl. sol. in H_2O from which it is partially pptd. by alcohol. More easily sol. in alkali carbonates or HCl+Aq. Most easily sol. in NaOH or KOH+Aq. (Herbst, Dissert. **1894.**)

Arsenic *pent*oxide, As_2O_5.

Deliquescent in moist air; slowly sol. in H_2O, forming H_3AsO_4, which see. Easly sol. in alcohol; much more sol. in alcohol than As_2O_3. Very sl. sol. in the fatty oils, 100 pts. of oil dissolving 0.2 pt. As_2O_5 in the cold, and 1 pt. with partial decomp. on boiling. (Berzelius.)
1000 pts. boiling poppy-oil dissolve 27 pts. As_2O_5; 1000 pts. boiling castor-oil dissolve 34 pts. As_2O_5. (Heimpel and Grundner.)

$+4H_2O$. Solubility in H_2O at t°.

t°	Pts. H_3AsO_4 in100 pts. solution	t°	Pts. H_3AsO_4 in 100 pts. solution
—55°	69.9	—5°	80.0
—50	70.9	0	81.0
—45	71.9	+5	82.1
—40	72.9	10	83.3
—35	73.9	15	84.7
—30	74.9	20	86.3
—25	75.9	25	88.0
—20	76.9	30	90.1
—15	77.9	35	92.8
—10	78.9	..	....

(Menzies and Potter, J. Am. Chem. Soc. 1912, **34.** 1464.)

$+{}^5/_3H_2O$. Solubility in H_2O at t°.

t°	Pts. H_3AsO_4 in 100 pts. of solution
+10°	88.4
20	89.1
30	89.8
40	90.5
50	91.2
60	91.9
70	92.6
80	93.2
90	93.8
100	94.4
110	95.0
120	95.6
130	96.2
140	96.8

(Menzies and Potter, J. Am. Chem. Soc. 1912, **34.** 1464.)

$As_2O_5+4H_2O$ and $3As_2O_5+5H_2O$ are the only hydrates that can be isolated. (Menzies and Potter.)

See also **Arsenic Acid.**

Arsenic *tri*oxide, *with* alkali haloid.

See **Arsenite, alkali haloid.**

Arsenic sulphur *tri*oxide, As_2O_3, SO_3.

Deliquescent; decomp. by H_2O. (Adie, Chem. Soc. **55.** 157.)

As_2O_3, $2SO_3$. As above. (Adie.)
As_2O_3, $3SO_3$. (Weber, B. **19.** 3186.)
As_2O_3, $4SO_3$. As above. (Adie.)
As_2O_3, $6SO_3$. (Weber.)
As_2O_3, $8SO_3$. As above. (Adie.)

Arsenic oxychloride, etc.

See **Arsenyl chloride,** etc.

Arsenic phosphide, AsP.

Decomp. by H_2O. Not attacked by cold H_2SO_4 or HCl, and only sl. sol. therein on warming. Easily decomp. by HNO_3, KOH, NaOH, BaO_2H_2+Aq. Insol. in alcohol, ether, chloroform; sl. sol. in CS_2.

$P_2As_3O_2$. Product of action of H_2O on above compound, which it resembles. (Janowsky, B. **6.** 216.)

Arsenic *mono*selenide, As_2Se.

Insol. in most organic and inorganic solvents. Sol. very slowly in conc. HCl and H_2SO_4. Sol. in boiling alkali hydroxides+Aq. (Szarvasy, B. 1897, **30.** 1245.)

Arsenic *tri*selenide, As_2S_3.

Partially sol. in KOH+Aq if boiled with it for a long time. (Uelsmann, A. **116.** 123.)

Arsenic *penta*selenide, As_2Se_5.

Insol. in most solvents, as conc. HCl. Sol. in alkali hydrates and sulpho-hydrates+Aq. (Szarvasy, B. 1895, **28.** 2655–2656.)

Insol. in H_2O, in dil. acids and in conc. HCl. Sl. sol. in warm HNO_3+Aq. Oxidized by cold fuming HNO_3. Sol. in alkalies and in hot alkali carbonates+Aq. Insol. in alcohol, ether, CS_2, etc. (Clever, Z. anorg. 1895, **10.** 129.)

Arsenic selenosulphide.

See **Arsenic sulphoselenide.**

Arsenic sulphide, As_3S.

Ppt. Insol. in NH_4OH or in colorless $(NH_4)_2S$+Aq. Sol. in yellow NH_4SH+Aq. (Scott, Chem. Soc. 1900, **77.** 652.)

Arsenic *di*sulphide, As_2S_2.

Min. *Realgar.* Difficultly sol. in alkali sulphides+Aq. Partly dissolved by KOH+Aq with decomposition. Sol. at 150° in a sealed tube in $NaHCO_3$+Aq, and crystallizes out on cooling. (Senarmont, A. ch. (3) **32.** 158.)

Arsenic *tri*sulphide, As_2S_3.

Insol. in H_2O when prepared in the dry way, but when prepared moist is very liable to go into the colloidal modification mentioned below. Insol. in H_2O containing H_2SO_4 HNO_3, HCl, $H_2C_2O_4$, $HC_2H_3O_2$, $H_2C_4H_4O_6$, CO_2, NH_4Cl, KNO_3, $(NH_4)_2SO_4$, $MgSO_4$. (Bontigny.)

Insol. in H_2O. Traces are dissolved by H_2S+Aq. Sl. decomp. by boiling with H_2O, or long contact with cold H_2O. (Fresenius.)

1 l. H_2O dissolves 2.1×10^{-6} mols. pptd. As_2S_3 at 18°. (Weigel, Z. phys. Ch. 1907, **58.** 294.)

Insol. in dil. acids. Insol. in cold, and scarcely attacked by hot conc. HCl+Aq.

Easily decomp. by HNO_3 or aqua regia.

Easily sol. in cold KOH, NaOH, or NH_4OH+Aq, also in alkali carbonates, or sulphates+Aq.

Sol. in hot $KHSO_3$+Aq.

Sol. in citric acid, and alkali citrates+Aq. (Spiller.)

Slowly sol. in cold 2% $Na_2B_4O_7$+Aq. Easily sol. on heating. (Materne, C. C. **1906,** II. 557.)

Insol. in CS_2.

Min. *Orpiment.*

As_2S_3 may also be obtained in a colloidal form, sol. in H_2O. Sat. solution contains 34.46% As_2S_3; it is decomp. by standing, but may be boiled without undergoing decomposition; most acids and many salts ppt. As_2S_3 (Schulze, J. pr. (2) **25.** 431.)

The following solutions cause pptn. of As_2S_3 in a solution of the colloidal modification, when added in the given state of dilution:—

HCl+Aq	1 : 555
HNO_3+Aq	1 : 276
H_2SO_4+Aq	1 : 255
H_2SO_3+Aq	1 : 138
$H_2C_2O_4$+Aq . . .	1 : 65
H_3PO_4+Aq	1 : 26
$HC_2H_3O_2$+Aq . . .	1 : 0.18
K_2SO_4+Aq	1 : 76
Na_2SO_4+Aq . . .	1 : 129
$(NH_4)_2SO_4$+Aq . . .	1 : 188
$CaSO_4$+Aq	1 : 2780
$MgSO_4$+Aq . . .	1 : 2630
$ZnSO_4$+Aq	1 : 3330
$MnSO_4$+Aq . . .	1 : 2860
$NiSO_4$+Aq	1 : 3440
$FeSO_4$+Aq	1 : 2380
$Al_2(SO_4)_3$+Aq . . .	1 : 52600
Tl_2SO_4+Aq	1 : 799
KCl+Aq	1 : 137
KBr+Aq	1 : 103
KI+Aq	1 : 55
LiI+Aq	1 : 127
NaCl+Aq	1 : 212
NH_4Cl+Aq . . .	1 : 207
$BaCl_2$+Aq	1 : 2860
$CaCl_2$+Aq	1 : 4370
$MgCl_2$+Aq	1 : 10000

$FeCl_3+Aq$	1 : 50000
$AlCl_3+Aq$	1 : 83000
$CrCl_3+Aq$	1 : 20000
KNO_3+Aq	1 : 84
$NaNO_3+Aq$	1 : 117
NH_4NO_3+Aq	1 : 138
$Ba(NO_3)_2+Aq$	1 : 2080
$KClO_3+Aq$	1 : 88
$CaH_2(CO_3)_2+Aq$	1 : 3120
$K_2C_2H_4O_6+Aq$	1 : 85
$K_2C_2O_4+Aq$	1 : 81
$NaC_2H_3O_2+Aq$	1 : 78
Urea+Aq	1 : 25
$(NH_4)_2Fe(SO_4)_2+Aq$	1 : 1160
$K_2Al_2(SO_4)_4+Aq$	1 : 50000
$K_2Fe_2(SO_4)_4+Aq$	1 : 55500
$K_2Cr_2(SO_4)_4+Aq$	1 : 25000
$K_4Fe(CN)_6+Aq$	1 : 67
$K_3Fe(CN)_6+Aq$	1 : 81

Cold conc. solutions of boric, arsenious, tartaric, benzoic, and salicylic acids, also cane sugar, or chloral hydrate cause no pptn. Absolute alcohol and glycerine may also be mixed with the solutions without causing pptn. (Schulze, J. pr. (2) **25.** 442.)

$+6H_2O$; decomp. completely into As_2S_3 under a pressure of 6000 to 7000 atmos. (Spring, Z. anorg. 1895, **10.** 186.)

Arsenic *penta*sulphide, As_2S_5.

Insol. in H_2O. Sol. in NH_4OH, KOH, NaOH+Aq, and solutions of alkali sulphides and carbonates. Sol. in BaO_2H_2, and CaO_2H_2 +Aq.

Sol. in citric acid, and alkali citrates+Aq. (Spiller.)

Alcohol dissolves out S on boiling. (Berzelius.)

Sol. in alkali arsenates+Aq. (Nilson, J. pr. (2) **14.** 155.)

$+H_2O$. (Nilson, *l.c.*)

Arsenic *tri*sulphide, *with* M_2S.
See **Sulpharsenites, M.**

Arsenic *penta*sulphide, *with* M_2S.
See **Sulpharsenates, M.**

Arsenic sulphobromide, $AsS_2Br_3=AsSBr+SBr_2$.

Decomp. by H_2O. (Hannay, Chem. Soc. **33.** 284.)

Arsenic sulphochloride, As_2S_5Cl.

Slowly decomp. by boiling H_2O. Sol. in hot $AsCl_3$ without decomp. (Ouvrard, C. R. **116.** 1516.)

AsS_2Cl. Decomp. by H_2O. Sol. in NH_4OH, and alkali carbonates+Aq. (Ouvrard.)

AsS_2Cl. Slowly decomp. by boiling H_2O. Sol. in alkali carbonates and in NH_4OH+Aq. (Ouvrard, C. R. 1893, **116.** 1517.)

Arsenic sulphoiodide, AsSI.

Insol. in alcohol, chloroform or carbon disulphide. (Schneider, J. pr. (2) **23.** 486.)

Formula is probably As_2S_3, AsI_3.

Slowly attacked by HCl+Aq; somewhat more easily by HNO_3+Aq. Easily sol. in KOH, or NH_4OH+Aq. (Schneider, J. pr. (2) **34.** 505.)

$2AsI_3$, SI_6. Decomp. on air. (Schneider, J. pr. (2) **36.** 509.)

$As_4S_5I_2$. Less sol. in CS_2 than AsI_3. (Ouvrard, C. R. **117.** 107.)

As_2SI_4. (Ouvrard.)

See also **Arsenyl sulphoiodide.**

Arsenic sulphoselenide, As_2SeS_2.

Easily sol. in cold NH_4SH+Aq. Nearly completely sol. in $(NH_4)_2CO_3$+Aq. (v. Gerichten, B. **7.** 29.)

As_2SSe_2. More difficultly sol. than the preceding comp. in NH_4SH+Aq. (v. Gerichten.)

$As_2Se_2S_3$. Sp. gr. = 6.402 at ca. 750°.

Insol. in most solvents. Easily sol. in alkali hydroxides and sulphides+Aq. (Szarvasy, B. 1895, **28.** 2661.)

$As_2Se_3S_2$. Sp. gr. = 11.35 at 550–600°.

Insol. in most solvents. Easily sol. in alkali hydroxides and sulphides+Aq. (Szarvasy, B. 1895, **28.** 2659.)

Arsenic telluride, As_2Te_2.

Sol. in HNO_3 and HNO_3+HCl+Aq. (Oppenheim, J. pr. **71.** 266.)

As_2Te_3. As above. (Oppenheim.)

Arsenic acid, anhydrous, As_2O_5.

See **Arsenic *pent*oxide.**

*Meta*arsenic acid, $HAsO_3$.

Slowly sol. in cold, quite easily sol. in hot H_2O, with considerable evolution of heat, and conversion into H_3AsO_4. (Kopp, A. ch. (3) **48.** 196.)

*Ortho*arsenic acid, H_3AsO_4.

Sol. in H_2O, with absorption of heat.

1 pt. As_2O_5 dissolves in 0.405 pt. H_2O at 12.5°, or 100 pts. H_2O dissolve 244.81 pts. As_2O_5 at 12.5°. (Vogel.)

Sol. in 0.5 pt. H_2O. (Thénard.)

Sol. in 6 pts. cold H_2O, and more quickly in 2 pts. hot H_2O. (Bucholz.)

100 pts. H_2O at 15.56° dissolve 150 pts. As_2O_5. (Ure's Dict.)

H_3AsO_4+Aq sat. at 15° contains 15% As_2O_5.

Sp. gr. of H_3AsO_4+Aq at 15°: *a*=sp. gr. if % is As_2O_5; *b*=sp. gr. if % is H_3AsO_4.

%	*a*	*b*	%	*a*	*b*
5	1.042	1.0337	45	1.540	1.3973
10	1.085	1.0690	50	1.635	1.4617
15	1.134	1.1061	55	1.742	1.5320
20	1.187	1.1457	60	.....	1.6086
25	1.245	1.1882	65	.....	1.6919
30	1.306	1.2342	70	.....	1.7827
35	1.378	1.2840	75	.....	......
40	1.453	1.3382	..	.....	......

(Schiff, A. **113.** 183, calculated by Gerlach, Z. anal. **27.** 303.)

Sp. gr. of H_3AsO_4+Aq at 15°: a = sp. gr. if % is As_2O_5; b = sp. gr. if % is H_3AsO_4.

%	a	b	%	a	b
1	1.008	1.006	47	1.564	1.412
2	1.016	1.013	48	1.582	1.425
3	1.023	1.019	49	1.601	1.437
4	1.031	1.026	50	1.620	1.450
5	1.039	1.032	51	1.642	1.464
6	1.048	1.039	52	1.663	1.478
7	1.057	1.046	53	1.685	1.491
8	1.065	1.052	54	1.706	1.505
9	1.074	1.059	55	1.728	1.519
10	1.083	1.066	56	1.752	1.534
11	1.092	1.073	57	1.777	1.549
12	1.102	1.081	58	1.801	1.564
13	1.111	1.088	59	1.825	1.579
14	1.121	1.096	60	1.850	1.594
15	1.130	1.103	61	1.880	1.610
16	1.140	1.111	62	1.910	1.626
17	1.150	1.119	63	1.940	1.643
18	1.160	1.126	64	1.970	1.659
19	1.170	1.134	65	2.000	1.675
20	1.180	1.142	66	2.030	1.693
21	1.191	1.150	67	2.060	1.712
22	1.203	1.158	68	2.090	1.730
23	1.214	1.167	69	2.120	1.749
24	1.226	1.175	70	2.150	1.767
25	1.237	1.183	71	.....	1.788
26	1.249	1.192	72	.....	1.809
27	1.261	1.201	73	.....	1.830
28	1.274	1.210	74	.....	1.851
29	1.286	1.219	75	.....	1.872
30	1.298	1.228	76	.....	1.897
31	1.312	1.238	77	.....	1.921
32	1.325	1.248	78	.....	1.946
33	1.339	1.257	79	.....	1.970
34	1.352	1.267	80	.....	1.995
35	1.366	1.277	81	.....	2.020
36	1.381	1.288	82	.....	2.045
37	1.396	1.299	83	.....	2.070
38	1.411	1.309	84	.....	2.095
39	1.426	1.320	85	.....	2.120
40	1.441	1.331	86	.....	2.149
41	1.458	1.342	87	.....	2.178
42	1.475	1.353	88	.....	2.207
43	1.492	1.366	89	.....	2.236
44	1.509	1.376	90	.....	2.265
45	1.526	1.387	91	.....	2.295
46	1.545	1.400	..	.....	.....

(Kopp, calculated by Gerlach, Z. anal. **27.** 316.)

See also Arsenic *pent*oxide.

***Pyro*arsenic acid,** $H_4As_2O_7$.

Very deliquescent; easily sol. in H_2O with evolution of much heat, and conversion into H_3AsO_4.

Arsenates.

Arsenates of the alkali metals, and acid arsenates of the alkaline-earth metals are sol. in H_2O. Neutral and basic arsenates are easily sol. in mineral acids, including H_3AsO_4; less sol. in $HC_2H_3O_2$+Aq. The neutral alkaline-earth arsenates are less sol. in NH_4OH+Aq than in H_2O, but more sol. in NH_4Cl+Aq (Field). The alkali arsenates are sol. in hot glycerine. (Lefèvre, C. R. **108.** 1058.)

Aluminum arsenate, $Al_2(AsO_4)_2$.

Ppt. Insol. in H_2O; difficultly sol. in acids. (Coloriano, C. R. **103.** 273.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4328.)

$2Al_2O_3$, $3As_2O_5$. Nearly unattacked by boiling H_2O; sol. in dil. acids. (Lefèvre, A. ch. (6) **27.** 5.)

Aluminum potassium arsenate, $2Al_2O_3$, $3K_2O$, $3As_2O_5$.

(Lefèvre.)

Aluminum sodium arsenate, $2Al_2O_3$, $3Na_2O$, $3As_2O_5$.

(Lefèvre.)

Ammonium arsenate, $(NH_4)_3AsO_4+3H_2O$.

Difficultly sol. in H_2O. Less sol. in H_2O than $(NH_4)_2HAsO_4$. (Mitscherlich.)

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 826.)

Ammonium hydrogen arsenate, $(NH_4)_2HAsO_4$.

Effloresces, giving off NH_3; more sol. in H_2O than $(NH_4)_3AsO_4$. (Salkowsky, J. pr. **104.** 129.)

Insol. in acetone. (Eidmann, C. C. **1899,** II. 1014.)

Ammonium *di*hydrogen arsenate, $NH_4H_2AsO_4$.

Not efflorescent. Very sol. in H_2O.

Ammonium barium arsenate, $NH_4BaAsO_4+\frac{1}{2}H_2O$.

Sol. by 10 days' contact in 1391 pts. H_2O; in 18,832 pts. of a mixture of 1 pt. NH_4OH+Aq and 3 pts. H_2O; in 227 pts. of a solution of 1 pt. NH_4Cl in 10 pts. H_2O; and in 2169 pts. of a solution of 1 pt. NH_4Cl in 10 pts. NH_4OH+Aq and 60 pts. H_2O. (Lefèvre, A. ch. 1892, (6) **27.** 13.)

$(NH_4)_2BaH_2(AsO_4)_2$. Efflorescent. Insol. in H_2O; easily sol. in dil. HNO_3+Aq. (Baumann, Arch. Pharm. **36.** 36.)

Ammonium calcium arsenate, $NH_4CaAsO_4+\frac{1}{2}H_2O$.

1000 pts. pure H_2O dissolve 0.20 pt. this salt; 1000 pts. NH_4Cl+Aq (containing 50 pts. NH_4Cl) dissolve 4.15 pts. this salt; 900 pts. H_2O+100 pts. NH_4OH (sp. gr. = 0.880) dissolve 0.01 pt. this salt. (Field, Chem. Soc. **11.** 6.)

Soluble by 10 days' contact in 2167 pts. H_2O at 15°; in 381 pts. NH_4Cl+Aq (1 : 7); in

43478 pts. NH_4OH+Aq (1 : 3); in 10570 pts. NH_4Cl+NH_4OH+Aq (1 : 10 : 60). (Lefèvre, A. ch. 1892, (6) **27.** 13.)

$+6H_2O$. Sol. in hot, very sl. sol. in cold H_2O; sl. sol. in NH_4Cl, and NH_4OH+Aq. (Wach, Schw. J. **12.** 285.)

$+7H_2O$. (Bloxam, C. N. **54.** 163.)

$(NH_4)_2CaH_2(AsO_4)_2$. Efflorescent. Insol. in H_2O; easily sol. in dil. HNO_3+Aq. (Baumann, Arch. Pharm. **36.** 36.)

$(NH_4)Ca_3H_2(AsO_4)_3+3H_2O$.

$(NH_4)Ca_6H_5(AsO_4)_6+3H_2O$. (Bloxam, C. N. **54.** 163.)

Ammonium glucinum arsenate, $NH_4GlAsO_4+4\frac{1}{2}H_2O$.

More stable than the corresponding potassium salt. (Bleyer, Z. anorg. 1912, **75.** 291.)

Ammonium iron (ferric) *di*hydrogen arsenate, $NH_4H_2AsO_4$, $FeAsO_4$.

Hydrolyzed by H_2O.

Sol. in cold conc. HCl, hot HNO_3, hot dil. H_2SO_4, and in hot arsenic acid+Aq containing 75% arsenic pentoxide.

Sol. in hot conc. NH_4OH+Aq. Completely hydrolyzed by caustic alkalies.

Insol. in conc. NH_4Cl+Aq and in 50% acetic acid. (Curtman, J. Am. Chem. Soc. 1910, **32.** 628.)

Ammonium magnesium arsenate, NH_4MgAsO_4.

Sl. sol. in H_2O. Sol. in acids.

Anhydrous salt is sol. in 2784 pts. H_2O at 15°; in 15,904 pts. NH_4OH+Aq (1 : 3) (0.96 sp. gr.); in 1386 pts. NH_4Cl+Aq (1 : 70); in 886.7 pts. NH_4Cl+Aq (1 : 7); in 3014 pts. NH_4Cl (1 pt.)+NH_4OH (0.96 sp. gr.) (10 pts.)+Aq (60 pts.); in 32,827 pts. magnesia mixture. (Fresenius, Z. anal. **3.** 206.)

Anhydrous salt is sol. in 4389 pts. NH_4NO_3+Aq (1 : 50); in 2561.5 pts. KCl+Aq (1 : 165); in 1422 pts. ammoniacal solution of 3.5 g. tartaric acid in 250 cc. H_2O; in 933.5 pts. ammoniacal solution of 2.5 g. citric acid in 250 cc. H_2O. (Puller, Z. anal. **10.** 62.)

$+\frac{1}{2}H_2O$.

Sol. in 2656 pts. H_2O at 15°; in 15,038 pts. NH_4OH+Aq (1 : 3) (0.96 sp. gr.); in 844 pts. NH_4Cl+Aq (1 : 7); in 1315 pts. NH_4Cl+Aq (1 : 70); in 2871 pts. NH_4Cl (1 pt.)+NH_4OH (0.96 sp. gr.) (10 pts.)+Aq (60 pts.). (Fresenius.)

1000 pts. pure H_2O dissolve 0.14 pt. salt; 1000 pts. NH_4Cl+Aq (containing 100 pts. NH_4Cl) dissolve 0.95 pt. salt; 900 pts. H_2O +100 pts. NH_4OH (sp. gr. 0.880) dissolve 0.07 pt. salt. (Field, Chem. Soc. **11.** 6.)

$+6H_2O$. Sl. efflorescent. Sl. sol. in H_2O. Very sl. sol. in NH_4OH+Aq.

Solubility of $NH_4MgAsO_4+6H_2O$ in H_2O and NH_4 salts+Aq.
Grams salt dissolved in 100 g. solvent.

t°	H_2O	5% NH_4NO_3+Aq	5% NH_4Cl+Aq	NH_4OH+Aq 1 pt. NH_4OH+Aq (0.96) +4 pts. H_2O	4% NH_4OH+Aq +5% NH_4Cl+Aq	4% NH_4OH+Aq +10% NH_4Cl+Aq
0°	0.03388	0.09216	0.08397	0.00874	....	....
20	0.02066	0.11358	0.12284	0.00958	0.01331	0.03165
30	....	0.11758	0.11264	....	....	....
40	0.02746	0.13936	0.19016	0.01173	....	....
50	0.02261	0.18945	0.18889	0.01005	....	....
60	0.02103	0.21115	0.21952	0.00902	0.04691	0.05353
70	0.01564	0.18880	0.22092	0.00949	....	....
80	0.02364	0.18945	0.23144	0.00912	....	....

(Wenger, Dissert. **1911.**)

Ammonium manganous arsenate, $NH_4MnAsO_4+6H_2O$.

Nearly insol. in cold H_2O; easily sol. in dil. acids; insol. in alcohol. (Otto, J. pr. **2.** 414.)

Ammonium sodium arsenate, $NH_4NaHAsO_4+4H_2O$.

Sol. in H_2O. (Uelsmann, Zeit. f. ges. Nat. **23.** 347.)

Ammonium sodium hydrogen arsenate, $(NH_4)_3Na_3H_6(AsO_4)_4+6H_2O$.

Sol. in H_2O. (Filhol and Senderens, C. R. **94.** 649.)

Ammonium strontium arsenate, $NH_4SrAsO_4+\frac{1}{2}H_2O$.

Sol. by 10 days' contact in 3229 pts. H_2O, in 11,586 pts. dil. NH_4OH+Aq, in 199 pts. of a mixture of 1 pt. NH_4Cl in 7 pts. H_2O, and in 1519 pts. of a solution of 1 pt. NH_4Cl in 10 pts. NH_4OH+Aq and 60 pts. H_2O. (Lefèvre, A. ch. 1892, (6) **27.** 13.)

Ammonium uranyl arsenate, $NH_4(UO_2)AsO_4+xH_2O$.

Insol. in H_2O, $HC_2H_3O_2$, and saline solutions as NH_4Cl+Aq; sol. in mineral acids. (Puller, Z. anal. **10.** 72.)

Ammonium vanadium arsenate, $NH_4(VO_2)_2AsO_4$, and $(NH_4)_2HAsO_4+2(VO_2)_2H_2AsO_4$.

See **Arseniovanadate, ammonium.**

Ammonium arsenate tellurate.

See **Arseniotellurate, ammonium.**

Antimony arsenate (?).

Insol. in H_2O; insol. in acids after ignition, but when fresh is sol. in conc. boiling $HCl+Aq$, and sl. sol. in HNO_3+Aq. (Dumas.)

Barium arsenate, $Ba_3(AsO_4)_2$.

1000 pts. pure H_2O dissolve 0.55 pt. $Ba_3(AsO_4)_2$; 1000 pts. NH_4Cl+Aq (containing 50 pts. NH_4Cl) dissolve 1.95 pts. $Ba_3(AsO_4)_2$; 900 pts. H_2O+100 pts. NH_4OH+Aq (sp. gr. $=0.88$) dissolve 0.03 pt. $Ba_3(AsO_4)_2$. (Field, Chem. Soc. **11.** 6.)

Sol. in cold HNO_3, and $HCl+Aq$ (Berzelius); $H_2C_4H_4O_6$, and $HC_2H_3O_2+Aq$. (Anthon.)

Solubility in H_2O is not increased by presence of NH_4, Na, or K salts. (Laugier.)

Not pptd. in presence of Na citrate. (Spiller.)

$+1\frac{1}{2}H_2O$. (Salkowsky, J. pr. **104.** 129.)

Barium hydrogen arsenate, $BaHAsO_4+1\frac{1}{2}H_2O$.

Very sl. sol. in H_2O, but decomp. thereby into $Ba_3(AsO_4)_2$ and $BaH_4(AsO_4)_2$. (Berzelius.)

Sl. sol. in cold acids.

$+H_2O$. Sl. sol. in either $BaCl_2+Aq$ or Na_2HAsO_4+Aq. (Maumené, J. B. **1864.** 237.)

Barium *tetra*hydrogen arsenate, $BaH_4(AsO_4)_2+2H_2O$.

Easily sol. in H_2O. (Setterberg, Berz. J. B. **26.** 206.)

Difficultly sol. in little, but decomp. by much H_2O. Easily sol in $HCl+Aq$, less easily in $HC_2H_3O_2+Aq$ (Hörmann, Dissert, **1879.**)

Barium arsenate, acid, $BaO, 2As_2O_5+4H_2O$.

Very sl. sol. in H_2O. (Mitscherlich.)

Barium *pyro*arsenate, $Ba_2As_2O_7$.

Insol. in H_2O, but decomp. thereby into $BaHAsO_4+H_2O$. (Lefèvre, C. R. **108.** 1058.)

Barium potassium arsenate, $BaKAsO_4$.

Sl. decomp. by cold H_2O; rapidly sol. in dil. acids. (Lefèvre, A. ch. (6) **27.** 1.)

Barium sodium arsenate, $BaNaAsO_4+9H_2O$.

(Joly, C. R. 1887, **104.** 1702.)

Barium arsenate chloride, $3Ba_3(AsO_4)_2, BaCl_2$.

Insol. in H_2O; sol. in dil. HNO_3+Aq. (Lechartier, C. R. **65.** 172.)

Bismuth arsenate, basic, $BiAsO_4, 3Bi_2O_3$.

Insol. in H_2O. Sol. in mineral acids. (Cavazzi, Gazz. ch. it. **14.** 289.)

$5Bi_2O_3, 2As_2O_5+8H_2O$. Min. *Rhagite.*

Easily sol. in $HCl+Aq$; sl. sol. in HNO_3+Aq.

Bismuth arsenate, $BiAsO_4+\frac{1}{2}H_2O$.

Insol. in H_2O. Insol. in HNO_3+Aq in presence of H_3AsO_4, or alkali arsenates$+Aq$; sol. in $HCl+Aq$. (Salkowsky, J. pr. **104.** 129.)

Not wholly insol. in HNO_3+Aq. (Schneider, J. pr. (2) **20.** 418.)

Very sol. in H_3AsO_4+Aq. (Dumas.)

Insol. in $Bi(NO_3)_3+Aq$. (Dumas.)

Sol. in $Bi(NO_3)_3+Aq$. (Salkowsky.)

Insol. in conc. $Bi(NO_3)_3+Aq$ containing a small quantity of HNO_3. (Schneider.)

Bismuth copper arsenate, $Bi_2Cu_{20}As_{10}H_{44}O_{70}=Bi_2O_3, 20CuO, 5As_2O_5+22H_2O$.

Min. *Mixite.* Decomp. by dil. HNO_3+Aq into insol. $BiAsO_4$, and $Cu_3(AsO_4)_2$, which goes into solution. (Dana.)

Bismuth uranyl arsenate, $Bi_2(AsO_4)_2, 8BiO_3H_3, (UO_2)_3(AsO_4)_2$.

Min. *Walpurgite.*

Cadmium arsenate, $Cd_3(AsO_4)_2$.

Ppt. (Salkowsky, J. pr. **104.** 129.)

$2CdO, As_2O_5$. (Lefèvre, C. R. **110.** 405.)

$5CdO, 2As_2O_5+5H_2O$. Ppt. (Salkowsky.)

Cadmium *pyro*arsenate, $Cd_2As_2O_7$.

(de Schulten.)

Cadmium hydrogen arsenate, $CdHAsO_4+H_2O$.

Decomp. by H_2O. (Demel, B. **12.** 1279.)

$CdH_4(AsO_4)_2+2H_2O$. Decomp. by excess of H_2O. (de Schulten, Bull. Soc. (3) **1.** 473.)

Cadmium potassium arsenate, $2CdO, K_2O, As_2O_5$.

(Lefèvre, C. R. **110.** 405.)

Cadmium sodium arsenate, $CdO, 2Na_2O, As_2O_5$.

Slowly sol. in dil. acids. (Lefèvre, C. R. **110.** 405.)

$2CdO, 4Na_2O, 3As_2O_5$. (Lefèvre.)

Cadmium arsenate bromide, $3Cd_3(AsO_4)_2, CdBr_2$.

Sol. in very dil. HNO_3+Aq. (de Schulten, Bull. Soc. (3) **1.** 472.)

Cadmium arsenate chloride, $3Cd_3(AsO_4)_2, CdCl_2$.

Sol. in very dil. HNO_3+Aq. (de Schulten.)

Cæsium arsenate, $Cs_2O, 2As_2O_5+5H_2O$.

Ppt. (Ephraim, Z. anorg. 1910, **65.** 246.)

Calcium arsenate, $Ca_3(AsO_4)_2+3H_2O$.

Ppt. Insol. in H_2O; sol. in H_3AsO_4+Aq. (Kotschoubey, J. pr. **49.** 182.)

Calcium *pyro*arsenate, $Ca_2As_2O_7$.

Slowly decomp. by cold H_2O into $CaHAsO_4+1\frac{1}{2}H_2O$. (Lefèvre.)

Calcium hydrogen arsenate, $CaHAsO_4+\frac{1}{2}H_2O$.

Insol. in H_2O. (Debray, A. ch. (3) **61.** 419.)

$+H_2O$. Min. *Haidingerite.* Easily sol. in acids.

$+2\frac{1}{2}H_2O$. Min. *Pharmacolite.* Easily sol. in acids.

$+3H_2O$. Insol. in H_2O; sol. in HCl, HNO_3, or H_3AsO_4+Aq; also in $(NH_4)_2SO_4$, NH_4NO_3, $NH_4C_2H_3O_2$, and NH_4Cl+Aq. (Pfaff.)

Calcium *tetra*hydrogen arsenate, $CaH_4(AsO_4)_2$.

Sol. in H_2O. (Graham.)

$+H_2O$. Sl. sol. in H_2O. Decomp. by much hot H_2O into H_3AsO_4 and $Ca_3(AsO_4)_2$. (Hörmann, Dissert. **1879.**)

Calcium iron (ferric) arsenate, $6CaO$, $4Fe_2O_3$, $5As_2O_5+15H_2O$ (?).

Min. *Arseniosiderite.* Sol. in acids.

Calcium magnesium arsenate, $Ca_5H_2(AsO_4)_4$, $Mg_5H_2(AsO_4)_4+10H_2O$.

Min. *Picropharmacolite.* Easily sol. in acids.

$Ca_3(AsO_4)_2$, $Mg_3(AsO_4)_2$. Sol. in HNO_3+Aq. (Kühn.)

Min. *Berzeliite.* Sol. in HNO_3+Aq.

$Ca_8Mg_6H_{14}(AsO_4)_{14}+49H_2O$. Min. *Wapplerite.*

Calcium potassium arsenate, $CaKAsO_4$.

(Lefèvre, A. ch. (6) **27.** 5.)

Calcium sodium arsenate, $CaNaAsO_4$.

(Lefèvre, A. ch. (6) **27.** 1.)

$4CaO$, $2Na_2O$, $3As_2O_5$. Not attacked by boiling H_2O; easily sol. in dil. acids. (Lefèvre.)

Calcium uranyl arsenate, $Ca(UO_2)_2(AsO_4)_2+8H_2O$.

Min. *Uranospinite.*

Calcium vanadium arsenate, $CaHAsO_4$, $2(VO_2)H_2AsO_4+8H_2O$.

See Arseniovanadate, calcium.

Calcium arsenate chloride, $Ca_3(AsO_4)_2$, $CaCl_2$.

Insol. in H_2O; sol. in dil. HNO_3+Aq. (Lechartier, C. R. **65.** 172.)

$3Ca_3(AsO_4)_2$, $CaCl_2$. As above. (Lechartier.)

Cerous arsenate, $CeHAsO_4$.

Insol. in H_2O. Sol. in arsenic acid+Aq. (Berzelius.)

Ceric hydrogen arsenate, $Ce(HAsO_4)_2+6H_2O$.

Ppt. Insol. in H_2O and dil. acids. (Barbieri, B. 1910, **43.** 2216.)

Ceric *di*hydrogen arsenate, $Ce(H_2AsO_4)_4+4H_2O$.

Sol. in conc. HNO_3. (Barbieri *l. c.*)

Chromic arsenate, $2Cr_2O_3$, $3As_2O_5$.

Insol. in H_2O and conc. boiling acids. (Lefèvre, A. ch. (6) **27.** 5.)

Chromic potassium arsenate, $2Cr_2O_3$, $3K_2O$, $3As_2O_5$.

(Lefèvre.)

Chromic sodium arsenate, $2Cr_2O_3$, $3Na_2O$, $3As_2O_5$.

(Lefèvre.)

Cobaltous arsenate, basic, $4CoO$, As_2O_5.

Easily sol. in acids. (Gentele, J. B. **1851.** 359.)

$Co(CoOH)AsO_4$. Insol. in H_2O; difficultly sol. in acids. (Coloriano.)

Cobaltous arsenate, $Co_3(AsO_4)_2+8H_2O$.

Ppt. Insol. even in boiling H_2O; easily sol. in HNO_3, HCl, and NH_4OH+Aq; sol. in H_3AsO_4+Aq (Proust); sol. in dil. $FeSO_4$+Aq. (Karsten, Pogg. **60.** 266.)

Min. *Cobalt bloom, Erythrite.* Easily sol. in acids.

$5CoO$, $2As_2O_5+3H_2O$. Insol. in H_2O; difficultly sol. in acids. (Coloriano, C. R. **103.** 273.)

$2CoO$, As_2O_5. Sl. attacked by boiling H_2O; easily sol. in dil. acids. (Lefèvre.)

Cobaltous hydrogen arsenate, $CoH_4(AsO_4)_2$.

Sol. in H_2O.

Cobaltous potassium arsenate, $CoKAsO_4$.

(Lefèvre.)

Cobaltous sodium arsenate, $CoNaAsO_4$.

(Lefèvre.)

$4CoO$, $2Na_2O$, $3As_2O_5$. (Lefèvre.)

Cobaltous vanadium arsenate, $Co(VO_2)_2H_2(AsO_4)_2+8H_2O$.

See Arseniovanadate, cobaltous.

Cobaltous arsenate ammonia, $Co_3(AsO_4)_2$, NH_3+7H_2O.

(Ducru, A. ch. 1901, (7) **22.** 185.)

$Co_3(AsO_4)_2$, $2NH_3+6H_2O$. (Ducru, *l. c.*)

$Co_3(AsO_4)_2$, $3NH_3+5H_2O$. (Ducru, *l. c.*)

Cuprous arsenate, $2Cu_2O$, As_2O_5.

(Hampe, Dissert. **1874.**)

$4Cu_2O$, As_2O_5. (Hampe, *l. c.*)

Cuprous *pyro*arsenate, $Cu_4As_2O_7$.

Ppt. Sol. in NH_4OH or KOH+Aq. (Reichard, B. 1898, **31.** 2166.)

Cupric arsenate, basic, $8CuO$, $As_2O_5+12H_2O$.

Min. *Chalcophyllite.* Easily sol. in acids and NH_4OH+Aq.

$6CuO$, $As_2O_5+3H_2O$. Min. *Aphanesite, Clioclasite.* Sol. in acids and ammonia.

$5CuO$, $As_2O_5+2H_2O$. Min. *Erinite.* Sol. in HNO_3+Aq.

$+5H_2O$. Min. *Cornwallite*. Sol. in acids, and NH_4OH+Aq.
$+9H_2O$. Min. *Tirolite*.
$4CuO, As_2O_5+H_2O$. Insol. in H_2O. (Debray, A. ch. (3) **61.** 423.)
Min. *Olivenite*. Sol. in acids, and NH_4OH+Aq; decomp. by hot KOH+Aq.
$+7H_2O$. Min. *Euchroite*. Sol. in HNO_3+Aq.
$+4\frac{1}{2}H_2O$. (Hirsch, C. C. **1891,** I. 15.)

Cupric arsenate, $Cu_3(AsO_4)_2$.
Insol. in H_2O. Easily sol. in HCl+Aq; sl. sol. in other acids; sol. in NH_4OH+Aq. (Coloriano, C. R. **103.** 273.)
Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)
Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 827.)
$+4H_2O$. Decomp. by hot H_2O. (Debray.)
$+5H_2O$. Min. *Trichalcite*. Easily sol. in cold HCl+Aq.

Cupric arsenate, acid, $5CuO, 2As_2O_5$.
Sol. in H_2SO_3+Aq. (Vogel.)
$+3H_2O$. (Salkowsky.)
+8, $9\frac{1}{2}$, and $12\frac{1}{2}H_2O$. (Hirsch.)
$CuHAsO_4+H_2O$. Insol. in H_2O. (Coloriano.)
$+1\frac{1}{2}H_2O$. Insol. in H_2O. (Debray, A. ch. (3) **61.** 419.)
$8CuO, 3As_2O_5+12H_2O$. (Hirsch.)

Cupric lead arsenate, $3CuO, PbO, As_2O_5+2H_2O$.
Min. *Bayldonite*. Nearly insol. in HNO_3+Aq.

Cupric potassium arsenate, $CuKAsO_4$.
Slowly sol. in NH_4OH+Aq; easily sol. in acids. (Lefèvre, A. ch. (6) **27.** 5.)
$8CuO, K_2O, As_2O_5$. Easily sol. in dil. acids. (Lefèvre.)

Cupric sodium arsenate, $CuNaAsO_4$.
(Lefèvre.)
$3CuO, Na_2O, 2As_2O_5$. Very sol. in dil. acids. (Lefevre.)
$2Cu_3(AsO_4)_2, NaH_2AsO_4+5H_2O$. Ppt. (Hirsch, C. C. **1891,** I. 15.)
$6Cu_3(AsO_4)_2, 2NaH_2AsO_4, Na_2HAsO_4+13\frac{1}{2}H_2O$, or $16H_2O$. Ppt. (Hirsch.)
$3Cu_3(AsO_4)_2, Na_2HAsO_4+9\frac{1}{2}H_2O$. Ppt. (Hirsch.)
$4Cu_3(AsO_4)_2, Na_2HAsO_4+11H_2O$. Ppt. (Hirsch.)

Cupric uranyl arsenate, $Cu(UO_2)_2(AsO_4)_2+8H_2O$.
(Werther, A. **68.** 312.)
Min. *Zeunerite*.

Cupric vanadium arsenate,
$Cu(VO_2)_2H_2(AsO_4)_2+3H_2O$.
See **Arseniovanadate, cupric.**

Cupric arsenate ammonia, $Cu_3(AsO_4)_2, 3NH_3+4H_2O$.
Insol. in cold or hot H_2O. (Damour, J. pr. **37.** 485.)
$2CuO, As_2O_5, 4NH_3+3H_2O$. Decomp. by H_2O. (Schiff, A. **123.** 42.)

Cupric arsenate calcium carbonate, $5CuO, As_2O_5, CaCO_3+4H_2O$, or $9H_2O$.
Min. *Tyrolite*. Easily sol. in acids, and NH_4OH+Aq.

Cupric arsenate sodium chloride, $2Cu_3(AsO_4)_2, NaCl+7\frac{1}{2}H_2O$.
Decomp. by hot H_2O. (Hirsch, Dissert. **1891.**)
$3Cu_3(AsO_4)_2, 2NaCl+13\frac{1}{2}H_2O$.
$+17\frac{1}{2}H_2O$. (Hirsch, *l.c.*)
$5Cu_3(AsO_4)_2, 3NaCl+23H_2O$. (Hirsch.)

Didymium arsenate, $Di_2H_3(AsO_4)_3$.
Ppt. Insol. in H_2O; sl. sol. in weak acids. (Marignac, A. ch. (3) **38.** 164.)
$5Di_2(AsO_4)_2, As_2O_5+3H_2O$. Ppt.

Glucinum arsenate, $Gl_3(AsO_4)_2$.
Insol. in H_2O; sol. in H_3AsO_4+Aq. (Berzelius.)

Glucinum hydrogen arsenate, $GlHAsO_4$.
Obtained in impure state by heating As_2O_5 with $Gl(OH)_2$ in a sealed tube at 220°. (Bleyer, Z. anorg. 1912, **75.** 287.)

Glucinum ***tetra*****hydrogen arsenate,** $GlH_4(AsO_4)_2$.
Very hydroscopic. (Bleyer, Z. anorg. 1912, **75.** 287.)

Glucinum potassium arsenate, $KGlAsO_4, \frac{1}{2}GlO+5H_2O$.
Unstable. Amorphous. Easily hydrolyzed, giving more basic salts. (Bleyer, Z. anorg. 1912, **75.** 289.)

Glucinum sodium arsenate, $NaGlAsO_4, \frac{1}{2}GlO+6H_2O$.
Unstable. Easily hydrolyzed. (Bleyer, Z. anorg. 1912, **75.** 290.)

Iron (ferrous) arsenate,* $Fe_3(AsO_4)_2+6H_2O$ (?).
Ppt. Sl. sol. in NH_4OH+Aq. Insol. in $(NH_4)_3AsO_4$+Aq or other NH_4 salts+Aq. (Wittstein.)
$+8H_2O$. Min. *Symplesite*. Sol. in HCl+Aq.

Iron (ferric) arsenate, basic, $16Fe_2O_3, As_2O_5+24H_2O$.
Insol. in NH_4OH+Aq. (Berzelius.)
$2Fe_2O_3, As_2O_5+12H_2O$. Insol. in NH_4OH+Aq.
$3Fe_2O_3, 2As_2O_5$.
$3Fe_2(AsO_4)_2, Fe_2O_6H_6+12H_2O$. Min. *Pharmacosiderite*. Easily sol. in acids; decomp. by KOH+Aq.

Iron (ferric) arsenate, Fe_2O_3, As_2O_5.

Ppt. Insol. in H_2O. Decomp. by hot H_2O. Sol. in HCl, H_2SO_4 and HNO_3. (Metzke, Z. anorg. 1898, **19.** 473.)

$+4H_2O$. Min. *Scorodite.* Easily sol. in HCl+Aq; insol. in HNO_3+Aq.

$+8H_2O$. Insol. in H_2O. When freshly pptd., sol. in NH_4OH+Aq. Sol. in HCl, or HNO_3+Aq. Insol. in $HC_2H_3O_2$, or NH_4 salts+Aq. (Wittstein.)

Sol. in warm H_2SO_3+Aq or $(NH_4)_2SO_3$+Aq. (Berthier, A. ch. (3) **7.** 79.)

Iron (ferric) arsenate, acid, $Fe_2O_3,3As_2O_5+16.7H_2O$.

Ppt.; sl. sol. in acids with a yellow color, and in NH_4OH+Aq with a red color. (Metzke, Z. anorg. 1898, **19.** 476.)

$2Fe_2O_3$, $3As_2O_5+12H_2O$. Insol. in H_2O or $HC_2H_3O_2$+Aq.

Sol. in mineral acids.

Sol. only in conc. H_3AsO_4+Aq.

Sol. in $(NH_4)_3AsO_4$, and other NH_4 salts +Aq. (Wittstein.)

Sol. in NH_4OH+Aq.

$+22\frac{1}{2}H_2O$. Ppt. Sl. sol. in acids with a yellow color, and in NH_4OH+Aq with a red color. (Metzke, Z. anorg. 1898, **19.** 475.)

Iron (ferroferric) arsenate, 6FeO, $3Fe_2O_3$, $4As_2O_5+32H_2O$.

Insol. in H_2O. Sol. in HCl+Aq. Decomp. by KOH+Aq. (Wittstein, J. B. **1866.** 243.)

Iron (ferric) lead arsenate, $5Fe_2(AsO_4)_2$, $Pb_3(AsO_4)_2$.

Min. *Carmine Spar. Carminite.* Sol. in acids; KOH+Aq dissolves out As_2O_5. (Sandberger.)

Iron (ferric) potassium arsenate, $2Fe_2O_3$, $3K_2O$, $3As_2O_5$.

Not attacked by boiling H_2O; easily sol. in dil. acids. (Lefèvre.)

Fe_2O_3, K_2O, $2As_2O_5$. (Lefèvre.)

Iron (ferric) sodium arsenate, Fe_2O_3, Na_2O, $2As_2O_5$.

(Lefèvre.)

$2Fe_2O_3$, $3Na_2O$, $3As_2O_5$. (Lefèvre.)

Lanthanum arsenate, $La_2H_3(AsO_4)_3$.

(Frerichs and Smith.)

Doubtful. (Cleve, B. **11.** 910.)

Lead arsenate, basic, $15PbO,2As_2O_5$ (?).

Ppt. (Strömholm, Z. anorg. 1904, **38.** 446.)

Lead arsenate, $Pb_3(AsO_4)_2$.

Insol. in H_2O, NH_4OH, or NH_4 salts+Aq. (Wittstein.)

Sol. in 2703.5 pts. $HC_2H_3O_2$+Aq containing 38.94% $HC_2H_3O_2$. (Bertrand, Monit. Scient. (3) **10.** 477.)

Sol. in sat. NaCl+Aq. (Becquerel, C. R. **20.** 1523.)

Not pptd. in presence of Na citrate. (Spiller.)

Lead *pyro*arsenate, $Pb_2As_2O_7$.

Insol. in H_2O or $HC_2H_3O_2$+Aq. Sol. in HCl, or HNO_3+Aq. (Rose.)

Decomp. by cold H_2O. (Lefèvre.)

$+H_2O=PbHAsO_4$. Ppt. (Salkowsky, J. pr. **104.** 109.)

Lead potassium arsenate, $PbKAsO_4$.

(Lefèvre, A. ch. (6) **27.** 5.)

Lead sodium arsenate, $PbNaAsO_4$.

(Lefèvre.)

4PbO, $2Na_2O$, $3As_2O_5$. Superficially decomp. by cold H_2O. (Lefèvre.)

Lead arsenate chloride, $3Pb_3(AsO_4)_2$, $PbCl_2$.

Sol. in dil. HNO_3+Aq. (Lechartier.)

Min. *Mimetite.* Sol. in HNO_3, and KOH+Aq.

Lithium arsenate, Li_3AsO_4.

Ppt. Sol. in dil. acids and in $HC_2H_3O_2$+Aq. (de Schulten, Bull. Soc. (3) **1.** 479.)

$LiH_2AsO_4+{}^3/_2H_2O$. Decomp. by H_2O into H_3AsO_4 and Li_3AsO_4. (Rammelsberg, Pogg. **128.** 311.)

Magnesium arsenate, $Mg_3(AsO_4)_2$.

Ppt.

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

$+7H_2O$, $+8H_2O$, $+10H_2O$, and $+22H_2O$. (Grühl, Dissert. **1897.**)

$+8H_2O$. Min. *Hörnesite.* Insol. in H_2O; easily sol. in acids.

Magnesium hydrogen arsenate, $MgHAsO_4$.

$+\frac{1}{2}H_2O$. Insol. in H_2O. (de Schulten, C. R. **100.** 263.)

$+5H_2O$. (Schiefer.)

$+6\frac{1}{2}H_2O$. Insol. in H_2O. 1000 pts. boiling H_2O dissolve 1.5 pts. (Thompson.)

Sol. in HNO_3+Aq before ignition, but insol. in acids after ignition. (Graham, A. **29.** 29.)

$+7H_2O$. Min. *Roesslerite.* Sol. in HCl+Aq.

Magnesium *tetra*hydrogen arsenate, $MgH_4(AsO_4)_2$.

Very deliquescent; sol. in H_2O. (Schiefer.)

Magnesium potassium arsenate, $MgKAsO_4$.

Insol. in, but decomp. by cold H_2O. (Rose.) Easily sol. in dil. acids. (Lefèvre.)

$+7H_2O$. (Kinkelin, Dissert, **1893.**)

4MgO, $2K_2O$, $3As_2O_5$. Not attacked by boiling H_2O; slowly sol. in dil. acids. (Lefèvre.)

Magnesium potassium hydrogen arsenate, $KMgH(AsO_4)_2+xH_2O$.

Decomp. by H_2O. (Kinkelin, Dissert. **1883.**)

$Mg_3KH_2(AsO_4)_3+5H_2O$. (Chevron and Droixhe, J. B. **1888,** 523.)

Magnesium potassium sodium arsenate, $Mg_2KNa(AsO_4)_2+10H_2O$.

(Kinkelin, Dissert. **1883.**)

Magnesium sodium arsenate, $MgNaAsO_4$.

Insol. in H_2O. Very sl. sol. in dil. acids. (Lefèvre.)

$4MgO, 2Na_2O, 3As_2O_5$. (Lefèvre.)

Magnesium vanadium arsenate, $MgH_2(VO_2)_2(AsO_4)_2+9H_2O$ and $MgHAsO_4, 2(VO_2)H_2AsO_4+9H_2O$.

See **Arseniovanadate, magnesium.**

Magnesium arsenate chloride, $Mg_3(AsO_4)_2, MgCl_2$.

Insol. in H_2O; sol. in dil. HNO_3+Aq. (Lechartier, C. R. **65.** 172.)

Magnesium arsenate fluoride, $Mg_3(AsO_4)_2, MgF_2$.

Insol. in H_2O; sol. in dil. HNO_3+Aq. (Lechartier.)

Manganous arsenate, basic, $6MnO, As_2O_5+3H_2O$ (?).

Min. *Chondroarsenite*. Easily and completely sol. in dil. HCl, and HNO_3+Aq.

Manganous arsenate, $Mn_3(AsO_4)_2+H_2O$.

Insol. in H_2O; sl. sol. in acids. (Coloriano, C. R. **103.** 273.)

$5MnO, 2As_2O_5+5H_2O$. Insol. in H_2O. (Coloriano.)

$2MnO, As_2O_5$. Sl. decomp. by cold H_2O, but rapidly on heating. (Lefèvre.)

$MnHAsO_4+H_2O$. Decomp. by boiling H_2O into $5MnO, 2As_2O_5+5H_2O$. Sol. in HNO_3, H_2SO_4, or H_3AsO_4+Aq.

Manganous *tetra*hydrogen arsenate, $MnH_4(AsO_4)_2$.

Deliquescent. Easily sol. in H_2O. (Schiefer.)

Manganous potassium arsenate, $MnKAsO_4$.

(Lefèvre, A. ch. (6) **27.** 5.)

Manganous sodium arsenate, $MnNaAsO_4$.

Very sol. in dil. acids. (Lefèvre.)

$2MnO, 4Na_2O, 3As_2O_5$. Not attacked by boiling H_2O; very sol. in dil. acids. (Lefèvre.)

Manganous arsenate chloride, $Mn_3(AsO_4)_2, MnCl_2$.

Insol. in H_2O; sol. in dil. HNO_3+Aq. (Lechartier, A. **58.** 259.)

Manganic arsenate, $Mn_2(AsO_4)_2+2H_2O$.

Insol. in H_2O; sol. in acids.

Mercurous arsenate, $(Hg_2)_3(AsO_4)_2$.

Insol. in H_2O; difficultly sol. in acids. (Coloriano, C. R. **103.** 273.) Ppt. (Haack, C. C. **1890,** II. 736.)

$Hg_2(AsO_3)_2$. Insol. in H_2O, $HC_2H_3O_2$, or alcohol. Decomp. by cold HCl+Aq. Sl. sol. in cold HNO_3+Aq, from which it is precipitated by NH_4OH as Hg_2HAsO_4. (Simon, Pogg. **41.** 424.)

Mercurous hydrogen arsenate, Hg_2HAsO_4.

Insol. in H_2O, $HC_2H_3O_2$, or NH_4OH+Aq. Decomp. by cold HCl+Aq; sol. in cold HNO_3 +Aq without decomp; very sl. sol. without decomp. in NH_4NO_3+Aq. (Simon, Pogg. **41.** 424.)

Mercuric arsenate, $Hg_3(AsO_4)_2$.

Ppt. Sol. in H_3AsO_4 or HNO_3+Aq. (Bergman.) Very sl. sol. in H_2O. Easily sol. in HCl+Aq. Sl. sol. in HNO_3+Aq. Insol. in H_3AsO_4+Aq. (Haack, C. C. **1890,** II. 736.)

Mercurous silver arsenate, Hg_2AgAsO_4.

Sol. in hot conc. HNO_3. (Jacobsen, Bull. Soc. 1909, (4) **5.** 948.)

Mercurous arsenate nitrate, $Hg_3AsO_4, HgNO_3+H_2O$.

Insol. in H_2O or $HC_2H_3O_2$; sol. in HNO_3+Aq. (Simon, Pogg. **41.** 424.)

$3Hg_3AsO_4, 2HgNO_3, 2Hg_2O$. Ppt. (Haack.)

Molybdenum arsenate.

Ppt.

Nickel arsenate, basic, $5NiO, As_2O_5$.

Min. —— (Bergemann.)

$Ni(NiOH)AsO_4$. Difficultly attacked by acids or alkalies. (Coloriano, Bull. Soc. (2) **45.** 241.)

$5NiO, 2As_2O_5+3H_2O$. As above.

Nickel arsenate, $Ni_3(AsO_4)_2$.

Min. —— (Bergemann.)

$+xH_2O$. Insol. in H_2O. Sol. in H_3AsO_4, and conc. mineral acids. Easily sol. in NH_4OH+Aq.

$+2H_2O$. Insol. in H_2O; difficultly sol. in acids. (Coloriano, Bull. Soc. **45.** 241.)

$+8H_2O$. Min. *Nickel-bloom, Annabergite*. Easily sol. in acids.

$NiHAsO_4+H_2O$. Sol. in H_2O. Difficultly attacked by acids. (Coloriano, C. R. **103.** 274.)

Nickel potassium arsenate, $12NiO, 3K_2O, 5As_2O_5$.

(Lefèvre.)

$2NiO, K_2O, As_2O_5$. Rapidly sol. in dil. acids. (Lefèvre.)

Nickel sodium arsenate, $NiNaAsO_4$.

Very slowly sol. in dil. acids. (Lefèvre.)

$4NiO, 2Na_2O, 3As_2O_5$. (Lefèvre.)

Nickel arsenate ammonia,

$Ni_3(AsO_4)_2, NH_3+7H_2O$.

$Ni_3(AsO_4)_2, 2NH_3+6H_2O$.

$Ni_3(AsO_4)_2, 3NH_3+5H_2O$. (Ducru, C. R. 1900, **131.** 703.)

Palladium arsenate (?).
Ppt.

Platinum arsenate (?).
Ppt. Sol. in HNO_3+Aq.

Potassium arsenate, K_3AsO_4.
Deliquescent. Very sol. in H_2O. (Graham, Pogg. **32.** 47.)
Insol. in ethyl acetate. (Naumann, B. 1904, **37.** 3601.)

Potassium hydrogen arsenate, K_2HAsO_4.
Sol. in H_2O.

Potassium *di*hydrogen arsenate, KH_2AsO_4.
Sol. in 5.3 pts. H_2O at 6°, forming a solution of sp. gr. 1.1134. Much more sol. in hot H_2O. Insol. in alcohol.

Sol. in 26,666 pts. boiling conc. alcohol. (Wenzel.)

Potassium sodium hydrogen arsenate, $KNaHAsO_4+16H_2O$.
Sol. in H_2O.
$K_3Na_3H_6(AsO_4)_4+9H_2O$. Sol. in H_2O, and not easily decomp. thereby into its constituents. (Filhol and Senderens, C. R. **95.** 343.)

Potassium strontium arsenate, $KSrAsO_4$.
(Lefèvre, C. R. **108.** 1058.)

Potassium vanadium arsenate, $K(VO_2)_2AsO_4+2\frac{1}{2}H_2O$.
See **Arseniovanadate, potassium.**

Potassium zinc arsenate, $KZnAsO_4$.
(Lefèvre.)

Potassium arsenate sulphate.
See **Arseniosulphate, potassium.**

Rhodium arsenate (?).
Ppt.

Rubidium *meta*arsenate, $RbAsO_3$.
Sol. in H_2O. (Bouchonnet, C. R. 1907, **144.** 642.)

Rubidium arsenate, $Rb_3AsO_4+2H_2O$.
Very hydroscopic; sol. in H_2O to give an alkaline solution. Absorbs CO_2 from the air. (Bouchonnet, *l.c.*)

Rubidium *pyro*arsenate, $Rb_4As_2O_7$.
(Bouchonnet, *l.c.*)

Rubidium hydrogen arsenate, Rb_2HAsO_4+ $+H_2O$.
Absorbs CO_2 from the air. Very hydroscopic; sol. in H_2O. Insol. in alcohol. (Bouchonnet, *l.c.*)

Rubidium *di*hydrogen arsenate, RbH_2AsO_4.
Not hydroscopic. Very sol. in H_2O; aq. solution is acid to litmus. (Bouchonnet, *l.c.*)

Silver arsenate, Ag_3AsO_4.
Insol. in H_2O. Sol. in acids; easily sol. in H_3AsO_4+Aq. (Joly, C. R. **103.** 1071.)
1 l. H_2O dissolves 0.0085 g. Ag_3AsO_4 at 20°. (Whitby, Z. anorg. 1910, **67.** 108.)
Much less sol. in H_3AsO_4 than Ag_3PO_4. (Graham.)
Sol. in NH_4OH+Aq. (Scheele.)
Sol. in $(NH_4)_2CO_3$+Aq. Insol. in NH_4 sulphate, nitrate, or succinate+Aq. (Wittstein.)
Very sl. sol. in NH_4NO_3+Aq, more easily in $HC_2H_3O_2$+Aq. (Graham.)
Sol. in $Na_2S_2O_3$+Aq, but not so easily as Ag_3PO_4.
Not pptd. in presence of Na citrate. (Spiller.)
Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 829.)

Silver hydrogen arsenate, Ag_2HAsO_4.
Decomp. by H_2O, with formation of Ag_3AsO_4. (Setterberg, Berz. J. B. **26.** 208.)
AgH_2AsO_4. Decomp. by H_2O. (Joly, C. R. **103.** 1071.)
$Ag_2O, 2As_2O_5$. Decomp. by H_2O. Rather sl. sol. in HNO_3+Aq. Very easily sol. in NH_4OH+Aq. (Hurtzig and Geuther, A. **111.** 168.)

Silver arsenate ammonia, $Ag_3AsO_4, 4NH_3$.
Easily sol. in H_2O. (Widmann, Bull. Soc. (2) **20.** 64.)

Silver arsenate sulphate, $3Ag_2O, As_2O_5, SO_3$.
Decomp. by H_2O, with separation of Ag_3AsO_4; decomp. by dil. H_2SO_4+Aq. (Setterberg, Berz. J. B. **26.** 209.)

Sodium arsenate, $Na_3AsO_4+12H_2O$.
Permanent in dry air. Sol. in 3.57 pts. H_2O at 15.5°. (Graham.) 100 pts. H_2O at 15.5° dissolve 28 pts. $Na_3AsO_4+12H_2O$. (Berzelius.) Sol. in 3.75 pts. H_2O at 17°; or 100 pts. H_2O at 17° dissolve 26.7 pts.; or sat. Na_3AsO_4+Aq at 17° contains 21.1% $Na_3AsO_4+12H_2O$ or 10.4% Na_3AsO_4, and has sp. gr. 1.1186. (Schiff, A. **113.** 350.)
Melts in crystal H_2O at 85.5°.

Sp. gr. of Na_3AsO_4+Aq at 17°.
% = % $Na_3AsO_4+12H_2O$.

%	Sp. gr.	%	Sp. gr.	%	Sp. gr.
1	1.0053	9	1.0490	17	1.0945
2	1.0107	10	1.0547	18	1.1003
3	1.0161	11	1.0603	19	1.1061
4	1.0215	12	1.0659	20	1.1121
5	1.0270	13	1.0716	21	1.1179
6	1.0325	14	1.0773	22	1.1238
7	1.0380	15	1.0830	..	......
8	1.0435	16	1.0887	..	......

(Schiff, calculated by Gerlach, Z. anal. **8.** 286.)

"Arseniate of soda" dissolves in 60 pts. boiling alcohol. (Wenzel.)

$+4\frac{1}{2}H_2O$. (Hall, Chem. Soc. **51.** 93.)
$+10H_2O$. Efflorescent. (Hall.)

Sodium hydrogen arsenate, $Na_2HAsO_4+7H_2O$.

Not efflorescent. (Schiff.)

Solubility in $Pb(NO_3)_2$+Aq. A table is given which records the g. of As_2O_5 in 100 cc. of the filtrate. (Curry, J. Am. Chem. Soc. 1915, **37.** 1685.)

$+7\frac{1}{2}H_2O$. (Lescoeur, C. R. **104.** 1171.)

$+12H_2O$. Efflorescent. Sol. in H_2O; sol. in 1.79 pts. H_2O at 14°; or 100 pts. H_2O at 14° dissolve 56 pts. $Na_2HAsO_4+12H_2O$. Sat. Na_2HAsO_4+Aq contains 35.9% $Na_2HAsO_4+12H_2O$, or 16.5% Na_2HAsO_4, and has sp. gr. = 1.1722. (Schiff, A. **113.** 350.)

100 pts. H_2O at 7.2° dissolve 22.268 pts. (Thompson.)

100 pts. H_2O dissolve 17.2 pts. $Na_2HAsO_4+12H_2O$ at 0°, and 140.7 pts. at 30°. (Tilden, Chem. Soc. **45.** 409.)

Melts in crystal H_2O at 28°. (Tilden.)

Sp. gr. of Na_2HAsO_4+Aq at 14°.
% = % $Na_2HAsO_4+12H_2O$.

%	Sp. gr.	%	Sp. gr.	%	Sp. gr.
1	1.0042	15	1.0665	29	1.1358
2	1.0084	16	1.0712	30	1.1410
3	1.0126	17	1.0759	31	1.1463
4	1.0168	18	1.0807	32	1.1516
5	1.0212	19	1.0855	33	1.1569
6	1.0256	20	1.0904	34	1.1623
7	1.0300	21	1.0953	35	1.1677
8	1.0344	22	1.1003	36	1.1731
9	1.0389	23	1.1052	37	1.1786
10	1.0434	24	1.1103	38	1.1841
11	1.0479	25	1.1153	39	1.1896
12	1.0525	26	1.1204	40	1.1952
13	1.0571	27	1.1255	..	......
14	1.0618	28	1.1306	..	......

(Schiff, calculated by Gerlach, Z. anal. **8.** 280.)

Insol. in alcohol.

$+13\frac{1}{2}H_2O$. (Setterberg.)

Sodium *di*hydrogen arsenate, $NaH_2AsO_4+H_2O$.

More sol. in H_2O than Na_3AsO_4 or Na_2HAsO_4. (Schiff.)

$+2H_2O$. Efflorescent. (Joly and Duffet, C. R. **102.** 1391.)

Sodium *tri*hydrogen *di*arsenate, $Na_3H_3(AsO_4)_2+3H_2O$.

Sol. in H_2O. (Filhol and Senderens, C. R. **95.** 343.)

Sodium strontium arsenate, $NaSrAsO_4$.

Not attacked by boiling H_2O. (Lefèvre.)

$+9H_2O$. Scarcely sol. in H_2O. (Joly, C. R. **104.** 905.)

$+18H_2O$. (Joly.)

Sodium uranyl arsenate, $Na(UO_2)AsO_4$.

Ppt. (Werther, A. **68.** 312.)

Sodium zinc arsenate, $NaZnAsO_4$.

Slowly sol. in dil. acids. (Lefèvre.)

$Na_2ZnAs_2O_7$. As above. (Lefèvre.)

Sodium arsenate fluoride, Na_3AsO_4, $NaF+12H_2O$.

Sol. in 9.5 pts. H_2O at 25°, and 2 pts. at 75°. (Briegleb, A. **97.** 95.)

Sodium arsenate stannate, $6Na_2O$, $2As_2O_5$, SnO_2+50H_2O.

More difficultly sol. than sodium stannate. (Haeffely, Phil. Mag. (4) **10.** 290.)

$5Na_3AsO_4$, $Na_2SnO_3+60H_2O$. (Prandtl, B. 1907, **40.** 2133.)

Sodium arsenate sulphate, $Na_8As_6O_{19}$, $2Na_2SO_4$.

Sol. in H_2O. (Mitscherlich.)

$Na_4As_2O_7$, Na_2SO_4. (Setterberg.)

Sodium arsenate tungstate, $Na_4As_2O_7$, $Na_2W_3O_{10}+20H_2O$.

See **Arseniotungstate, sodium.**

Strontium arsenate, $Sr_3(AsO_4)_2$.

Not attacked by boiling H_2O; easily sol. in dil. acids. (Lefèvre, A. ch. (6) **27.** 5.)

Strontium *pyro*arsenate, $Sr_2As_2O_7$.

Decomp. by cold H_2O into $SrHAsO_4+1\frac{1}{2}H_2O$. (Lefèvre.)

Strontium hydrogen arsenate, $SrHAsO_4+1\frac{1}{2}H_2O$.

Insol. in cold, but decomp. by hot H_2O into a basic, and a sol. acid salt. 100 pts. H_2O at 15.5° dissolve 0.284 pt. (Thompson, **1831.**)

Sol. in $HC_2H_3O_2$, and very easily in HCl+Aq. (Kotschoubey, J. pr. **49.** 182.)

Sol. in HNO_3+Aq.

$SrH_4(AsO_4)_2+2H_2O$. Partly sol. in H_2O. (Hörmann, Dissert. **1879.**)

Strontium vanadium arsenate, $SrHAsO_4$, $2(VO_2)H_2AsO_4+7\frac{1}{2}H_2O$.

See **Arseniovanadate, strontium.**

Strontium arsenate chloride, $3Sr_3(AsO_4)_2$, $SrCl_2$.

Insol. in H_2O; easily sol. in dil. HNO_3+Aq. (Lechartier, C. R. **65.** 172.)

Thallous arsenate, Tl_3AsO_4.

Sol. in H_2O. (Willm, A. ch. (4) **5.** 5.)

Thallous hydrogen arsenate, Tl_2HAsO_4.

Very easily sol. in H_2O. (Willm.)

Thallous *di*hydrogen arsenate, TlH_2AsO_4.

Easily sol. in H_2O. (Willm.)

Thallic arsenate, $TlAsO_4+2H_2O$.

Insol. in H_2O; sol. in HCl+Aq; decomp. by NH_4OH, or KOH+Aq. (Willm.)

Thorium hydrogen arsenate, $Th(HAsO_4)_2+6H_2O$.

Insol. in H_2O or H_3AsO_4+Aq. (Berzelius.)
Ppt.; insol. in H_2O. (Barbieri, C. A. **1911.** 3385.)
$Th(H_2AsO_4)_4+4H_2O$. Decomp. by H_2O. (Barbieri, *l. c.*)

Tin (stannous) arsenate, $SnHAsO_4+\frac{1}{2}H_2O$.

Insol. in H_2O. (Lenssen, A. **114.** 113.)

Tin (stannic) arsenate, $2SnO_2$, As_2O_5.

Ppt. Insol. in H_2O and dil. HNO_3+Aq. (Haeffely, Phil. Mag. (4) **10.** 290.)
$Sn_3(AsO_4)_4+6H_2O$. Insol. in H_2O; sol. in conc. HCl+Aq, and in aqua regia; insol. in HNO_3+Aq or H_2SO_4. (Williams, Proc. Soc. Manchester, **15.** 67.)
Colloidal.. Very slowly sol. in H_2O, from which it is pptd. by HCl, HNO_3, or H_2SO_4+Aq; also by $BaCl_2$, $CaCl_2$, NH_4Cl, and $FeCl_3$+Aq, and by $AgNO_3$, or KI+Aq. Not pptd. by alcohol, $HC_2H_3O_2$, $HgCl_2$, Na_2CO_3, K_2CO_3, or $(NH_4)_2CO_3$+Aq. The pptd. jelly is readily sol. in conc. acids, and KOH, or NaOH+Aq. (Williams, *l.c.*)

Tin (stannous) arsenate chloride, $Sn_3(AsO_4)_2$, $SnCl_2+2H_2O$.

Decomp. on air. (Lenssen, A. **114.** 113.)

Titanium arsenate (?).

Insol. in H_2O. Sol. in titanic acid, arsenic acid, or HCl+Aq. Sol. in Ti salts+Aq. (Rose.)

Titanyl arsenate, $5TiO_2$, $2As_2O_5$.

Sol. in acids without decomp. Scarcely attacked by KOH or by NH_4OH+Aq. (Reichard, B. 1894, **27.** 1026.)

Uranous arsenate, $U_3(AsO_4)_2$.

Ppt.

Uranous hydrogen arsenate, $UH_2(AsO_4)_2+3H_2O$.

Ppt. Sol. in HCl+Aq.

Uranyl arsenate, $(UO_2)HAsO_4+4H_2O$.

Insol. in H_2O, $HC_2H_3O_2$, and saline solutions, as NH_4Cl+Aq; sol. in the mineral acids; sol. in K_2CO_3+Aq. (Werther, A. **68.** 313.)
$(UO_2)H_4(AsO_4)_2+3H_2O$. (Werther.)
$(UO_2)_2As_2O_7$. Insol. in H_2O; sol. in acids.
$(UO_2)_3(AsO_4)_2+12H_2O$.
Min. *Troegerite.*

Vanadium *di*hydrogen arsenate, $(VO_2)H_2AsO_4+4H_2O$.

Easily sol. in H_2O. (Friedheim, B. **23.** 2600.)
See **Arseniovanadic acid.**

Vanadium zinc arsenate, $(VO_2)_2ZnH_2(AsO_4)_2+5\frac{1}{2}H_2O$, and $2(VO_2)H_2AsO_4+6\frac{1}{2}H_2O$.
See **Arseniovanadate, zinc.**

Vanadyl arsenate, $(VO)_2HAsO_4+H_2O$.

Very slowly sol. in H_2O; insol. in alcohol; easily sol. in HCl+Aq. (Berzelius.)
Composition given by Friedheim (B. **23.** 2600).

Yttrium arsenate, $YtHAsO_4$.

Ppt. Insol. in acetic, easily sol. in mineral acids.

Zinc arsenate, basic, $4ZnO$, $As_2O_5+H_2O$.

(Friedel, J. B. **1866.** 949.)
Min. *Adamite.* Easily sol. in dil. HCl+Aq, and is attacked by $HC_2H_3O_2$.

Zinc arsenate, $Zn_3(AsO_4)_2$.

(deSchulten, Bull Soc. (3) **2.** 300.)
$+3H_2O$. Ppt. Sol. in HNO_3, and H_3AsO_4+Aq. (Köttig, J. pr. **48.** 182.)
$+8H_2O$.
Min. *Köttigite.*

Zinc arsenate, acid, $Zn_5H_2(AsO_4)_4$.

Easily sol. in cold HCl+Aq, less easily in cold HNO_3. Sol. in KOH, or NaOH+Aq (Gorguel, Dissert, **1894.**)
$+3H_2O$. Insol. in H_2O; sol. in H_3AsO_4, or HNO_3+Aq. (Mitscherlich.)
$+5H_2O$. Sol. in dil. HCl+Aq. (Demel, B. **12.** 1279.) Could not be obtained, (Coloriano, Bull. Soc. (2) **45.** 709.)
$2ZnO$, As_2O_5. Very slowly decomp. by cold, rapidly by boiling H_2O. (Lefèvre.)
$ZnHAsO_4+H_2O$. Insol. in H_2O. (Debray, Bull. Soc. (2) **2.** 14.)
Decomp. by hot H_2O into $4ZnO$, $As_2O_5+H_2O$. (Coloriano, C. R. **103.** 273.)
$Zn(ZnOH)_2As_2O_7+7H_2O$ (Gorgeul.)

Zinc arsenate ammonia, $Zn_3(AsO_4)_2$, $2NH_3+3H_2O$.

Insol. in H_2O; sol. in acids, NH_4OH, or KOH+Aq. (Bette, A. **15.** 141.)

Zirconium arsenate, $2ZrO_2$, $As_2O_5+{}^5/_2H_2O = (ZrO)HAsO_4+\frac{3}{4}H_2O$.

Ppt. Insol. in H_2O or HCl+Aq. (Paykull, B. **6.** 1467.)

*Per*arsenic acid.

See **Perarsenic acid.**

Arsenicotungstic Acid.

Ammonium vanadium arsenicotungstate.

See **Arsenicovanadicotungstate, ammonium.**

Arsenicovanadicotungstic acid.

Ammonium arsenicovanadicotungstate, $16(NH_4)_2O$, $5As_2O_3$, $15V_2O_3$, $26WO_3+101H_2O$.

Sl. sol. in cold, readily sol. in hot H_2O. (Rogers, J. Am. Chem. Soc. 1903, **25.** 308.)

Arsenimide, $As_2(NH)_3$.

Decomp. by H_2O. (Hugot, C. R. 1904, **139.** 56.)

Arsenioarsenic acid, $3As_2O_3$, $2As_2O_5+3H_2O$.

Decomp. by H_2O. (Joly, C. R. **100.** 1221.)

$3As_2O_3$, $As_2O_5+H_2O$. Decomp. by H_2O. (Joly.)

As_2O_3, $As_2O_5+H_2O$. Decomp. by H_2O. (Joly.)

See also **Arsenic** *tri***oxide** *pent***oxide.**

Arseniochromic acid.

Ammonium arseniochromate, $2(NH_4)_2O$, As_2O_5, $4CrO_3+H_2O$.

Insol. in H_2O. (Friedheim and Mozkin, Z. anorg. 1894, **6.** 280.)

$3(NH_4)_2O$, As_2O_5, $8CrO_3$. Decomp. by recryst. from H_2O. (Friedheim and Mozkin, Z. anorg. 1894, **6.** 281.)

Potassium arseniochromate, $2K_2O$, As_2O_5, $4CrO_3$.

Decomp. by recryst. from H_2O. (Friedheim and Mozkin, Z. anorg. 1894, **6.** 275.)

$2K_2O$, As_2O_5, $4CrO_3+H_2O$. Decomp. by recryst. from H_2O. (Friedheim and Mozkin, *l. c.*)

Arseniomolybdic acid, As_2O_5, $6MoO_3+10H_2O$.

By recryst. from H_2O the comp. with $18H_2O$ is formed. (Pufahl, Dissert. **1888.**)

$+16H_2O$. Sol. in H_2O. (Debray.)

$+18H_2O$. Completely sol. in H_2O. Sp. gr. of sat. solution at 18.8° is 2.21. Easily sol. in abs. alcohol. Insol. in CS_2, liq. hydrocarbons and $CHCl_3$. (Pufahl, *l.c.*)

As_2O_5, $7MoO_3+14H_2O$. (Seyberth, B. **7.** 391.)

As_2O_5, $18MoO_3+28H_2O$. Very sol. in H_2O. Sp. gr. of sat. solution at 18.3° = 2.45 and 1 cc. contains 2.16 g. acid. Easily sol. in absolute alcohol; insol. in CS_2, liquid hydrocarbons and $CHCl_3$. (Pufahl, *l.c.*)

Sol. in ether with subsequent separation into two layers. *See* Phosphotungstic acid. (Drechsel, B. **20.** 1452.)

$+38H_2O$. Efflorescent. When recryst. comp. with $28H_2O$ is formed. (Pufahl, *l.c.*)

As_2O_5, $20MoO_3+27H_2O$. Sl. sol. in HNO_3+Aq. (Debray, C. R. **78.** 1408.)

Ammonium arseniomolybdate, $(NH_4)_2O$, As_2O_5, $2MoO_3+3H_2O$.

(Friedheim, Z. anorg. 1894, **6.** 28.)

$+4H_2O$. (Friedheim, *l.c.*)

$(NH_4)_2O$, As_2O_5, $6MoO_3+2H_2O$. Sl. sol. in cold H_2O; sol. in acids. (Debray.)

$+4H_2O$. Sl. sol. in cold, very easily sol. in hot H_2O. (Pufahl, *l.c.*)

$2(NH_4)_2O$, As_2O_5, $6MoO_3+6H_2O$. Sl. sol. in H_2O. Cannot be recryst. therefrom. (Pufahl.)

$+12H_2O$. (Friedheim, Z. anorg. 1894, **6.** 31.)

$3(NH_4)_2O$, As_2O_5, $6MoO_3+4H_2O$. (Friedheim, *l.c.*)

$+8H_2O$. (Friedheim, *l.c.*)

$(NH_4)_2O$, $2H_2O$, $7MoO_3$, $As_2O_5+4H_2O$. Sol. in hot H_2O. (Seyberth, B. **7.** 391.)

Not obtained. (Pufahl.)

$7(NH_4)_2O$, $2As_2O_5$, $14MoO_3+28H_2O$. (Friedheim, *l.c.*)

$5(NH_4)_2O$, As_2O_5, $16MoO_3+5H_2O$. (Friedheim, Z. anorg. 1894, **6.** 31.)

$5(NH_4)_2O$, As_2O_5, $16MoO_3+9H_2O$. Nearly insol. in cold, sol. in boiling H_2O. Easily sol. in NH_4OH+Aq. (Gibbs, Am. Ch. J. **3.** 402.)

$+12H_2O$. (Pufahl, *l.c.*)

$2(NH_4)_2O$, As_2O_5, $18MoO_3+17H_2O$. (Pufahl, *l.c.*)

$3(NH_4)_2O$, As_2O_5, $18MoO_3+14H_2O$. Very sol. in H_2O and alcohol. (Kehrmann, Z. anorg. 1894, **7.** 421.)

$3(NH_4)_2O$, As_2O_5, $20MoO_3$. Easily sol. in H_2O. (Debray, C. R. **78.** 1408.)

$3(NH_4)_2O$, As_2O_5, $24MoO_3+12H_2O$. Decomposed by H_2O, especially when boiling. Easily sol. in NH_4OH+Aq, less easily sol. in warm H_2SO_4 and boiling H_3AsO_4+Aq. Sl. sol. in molybdic acid+Aq, HNO_3, and conc. NH_4NO_3+Aq. (Pufahl, *l.c.*)

Barium arseniomolybdate, BaO, As_2O_5, $6MoO_3+10H_2O$.

Sl. sol. in H_2O. Partially decomp. by boiling. (Pufahl, *l.c.*)

$3BaO$, As_2O_5, $6MoO_3$. Sl. sol. in H_2O. (Pufahl, *l.c.*)

$3BaO$, As_2O_5, $7MoO_3$. Ppt. (Seyberth.)

$3BaO$, As_2O_5, $18MoO_3$. Decomp. by H_2O. (Pufahl, *l.c.*)

Cadmium arseniomolybdate, CdO, $2H_2O$, As_2O_5, $6MoO_3+11H_2O$.

(Pufahl.)

$3CdO$, $3H_2O$, As_2O_5, $18MoO_3+33H_2O$. (Pufahl.)

Cæsium arseniomolybdate, Cs_2O, As_2O_5, $6MoO_3$.

Sl. sol. in H_2O. (Pufahl, *l.c.*)

$4Cs_2O$, As_2O_5, $26MoO_3+15H_2O$. Ppt. (Ephraim, Z. anorg. 1910, **65.** 246.)

Calcium arseniomolybdate, CaO, As_2O_5, $6MoO_3+10H_2O$.

Rather difficultly sol. in cold H_2O. (Pufahl, *l.c.*)

$3CaO$, As_2O_5, $6MoO_3$. As Ba salt. (Pufahl, *l.c.*)

$3CaO$, As_2O_5, $18MoO_3+32H_2O$. Very sol. in H_2O. Solution sat. at 18° has sp. gr. = 2.163. (Pufahl, *l.c.*)

Cobalt arseniomolybdate, CoO, $2H_2O$, As_2O_5, $6MoO_3+11H_2O$.

(Pufahl.)

$3CoO$, $3H_2O$, As_2O_5, $18MoO_3+33H_2O$. (Pufahl.)

Cupric arseniomolybdate, CuO, $2H_2O$, As_2O_5, $6MoO_3+15H_2O$. (Pufahl.)

$3CuO$, $3H_2O$, As_2O_5, $18MoO_3+34H_2O$. (Pufahl.)

Lithium arseniomolybdate, Li_2O, As_2O_5, $6MoO_3+14H_2O$.

Very sol. in H_2O. (Pufahl, *l.c.*)

$3Li_2O$, As_2O_5, $18MoO_3+34H_2O$. Solution sat. at 15° has sp. gr. of 2.481. (Pufahl, *l.c.*)

Magnesium arseniomolybdate, MgO, As_2O_5, $6MoO_3+13H_2O$.

Very sol. in H_2O. (Pufahl, *l.c.*)

$3MgO$, As_2O_5, $18MoO_3+36H_2O$. Sol. in H_2O. (Pufahl, *l.c.*)

Manganese arseniomolybdate, MnO, $2H_2O$, As_2O_5, $6MoO_3+11H_2O$.

(Pufahl.)

$3MnO$, $3H_2O$, As_2O_5, $18MoO_3+33H_2O$. (Pufahl.)

Nickel arseniomolybdate, NiO, $2H_2O$, As_2O_5, $6MoO_3+11H_2O$.

(Pufahl.)

$3NiO$, $3H_2O$, As_2O_5, $18MoO_3+34H_2O$. (Pufahl.)

Potassium arseniomolybdate, K_2O, As_2O_5, $2MoO_3+5H_2O$.

Sol. in H_2O. (Friedheim, Z. anorg. **2.** 314.)

K_2O, As_2O_5, $6MoO_3+5H_2O$. Sol. in hot H_2O without decomp. (Friedheim, Z. anorg. 1892, **2.** 330.)

K_2O, As_2O_5, $18MoO_3+25H_2O$. Easily sol. in cold H_2O. Decomp. on dilution. (Pufahl, *l.c.*)

$3K_2O$, As_2O_5, $18MoO_3+26H_2O$. Easily sol. in H_2O. (Pufahl, *l.c.*)

$3K_2O$, As_2O_5, $20MoO_3$. Insol. in H_2O. (Debray, C. R. **78.** 1408.)

$3K_2O$, As_2O_5, $24MoO_3+12H_2O$. Somewhat sol. in H_2O acidified with HNO_3. (Pufahl, *l.c.*)

Rubidium arseniomolybdate, $3Rb_2O$, $3As_2O_5$, $5MoO_3+9H_2O$.

Easily sol. in H_2O. (Ephraim, Z. anorg. 1910, **65.** 241.)

Rb_2O, As_2O_5, $6MoO_3$. Sl. sol. in H_2O. (Pufahl, *l.c.*)

$4Rb_2O$, As_2O_5, $18MoO_3+40H_2O$. Pptd. (Ephraim, Z. anorg. 1910, **65.** 241–4.)

Silver arseniomolybdate, $3Ag_2O$, As_2O_5, $6MoO_3+xH_2O$.

(Pufahl, Leipzig, **1888.**)

$6Ag_2O$, As_2O_5, $18MoO_3+22H_2O$. Sl. sol. in H_2O. Very sol. in NH_4OH and in dil. HNO_3. (Pufahl, *l.c.*)

$7Ag_2O$, $2As_2O_5$, $36MoO_3+30H_2O$. Sl. sol. in cold, easily sol. in hot H_2O strongly acidified with HNO_3. (Pufahl, *l.c.*)

Sodium arseniomolybdate, Na_2O, As_2O_5, $2MoO_3+8H_2O$.

(Friedheim, Z. anorg. 1892, **2.** 357.)

Na_2O, As_2O_5, $6MoO_3+12H_2O$. Very sol. in H_2O. Solution sat. at 19.8° has sp. gr. = 1.678. (Friedheim, *l.c.*)

$3Na_2O$, As_2O_5, $6MoO_3+11H_2O$, $+12H_2O$, and $+13H_2O$. Sl. sol. in cold H_2O. (Pufahl, *l.c.*)

$3Na_2O$, As_2O_5, $18MoO_3+24H_2O$. Easily sol. in H_2O. (Pufahl, *l.c.*)

$+30H_2O$. Sl. sol. in cold H_2O. (Pufahl, *l.c.*)

Strontium arseniomolybdate, SrO, As_2O_5, $6MoO_3+10H_2O$.

As Ba salt. (Pufahl, *l.c.*)

$3SrO$, As_2O_5, $6MoO_3$. As Ba salt. (Pufahl, *l.c.*)

$3SrO$, As_2O_5, $18MoO_3+32H_2O$. Very sol. in H_2O. (Pufahl, *l.c.*)

Thallium arseniomolybdate, $6Tl_2O$, As_2O_5, $18MoO_3+xH_2O$.

Ppt. (Pufahl.)

$3Tl_2O$, $3H_2O$, As_2O_5, $18MoO_3+3H_2O$. Ppt. (Pufahl.)

Zinc arseniomolybdate, ZnO, $2H_2O$, As_2O_5, $6MoO_3+11H_2O$.

(Pufahl.)

$3ZnO$, As_2O_5, $18MoO_3+37H_2O$. Very sol. in H_2O. (Pufahl.)

Arseniophosphovanadicotungstic acid.

Ammonium arseniophosphovanadicotungstate, $88(NH_4)_2O$, $2As_2O_5$, $12P_2O_5$, $69V_2O_3$, $148WO_3+484H_2O$.

Sol. in H_2O. Insol. in alcohol and ether. (Rogers, J. Am. Chem. Soc. 1903, **25.** 313.)

Arseniophosphovanadicovanadiotungstic acid.

Ammonium arseniophosphovanadicovanadiotungstate, $99(NH_4)_2O$, $2As_2O_5$, $12P_2O_5$, $6V_2O_3$, $66V_2O_5$, $191WO_3+522H_2O$.

Sl. sol. in cold H_2O. (Rogers, J. Am. Chem. Soc. 1903, **25.** 314.)

Arseniophosphovanadiotungstic acid.

Ammonium arseniophosphovanadiotungstate, $82(NH_4)_2O$, $3As_2O_5$, $12P_2O_5$, $52V_2O_5$, $201WO_3+567H_2O$.

Very sol. in warm H_2O. Insol. in organic solvents. (Rogers, J. Am. Chem. Soc. 1903, **25.** 312.)

Arseniosulphuric acid.

Ammonium arseniosulphate, $2(NH_4)_2O$, As_2O_5, $2SO_3+3H_2O$.

Can be recryst. from H_2O. (Friedheim and Mozkin, Z. anorg. 1894, **6.** 290.)

Potassium arseniosulphate, $2K_2O$, As_2O_5, $2SO_3+3H_2O$.

(Friedheim and Mozkin, Z. anorg. 1894, **6** 289.)

$5K_2O$, As_2O_5, $8SO_3+6H_2O$. (Friedheim and Mozkin, Z. anorg. 1894, **6.** 291.)

Sodium arseniosulphate, $2Na_2O$, As_2O_5, $2SO_3+3H_2O$.

(Friedheim and Mozkin, Z. anorg. 1894, **6.** 290.)

Arseniotelluric acid.

Ammonium arseniotellurate, $2(NH_4)_2O$, As_2O_5, TeO_3+4H_2O.

Sol. in H_2O. (Weinland, Z. anorg. 1901, **28.** 65.)

$4(NH_4)_2O$, $3As_2O_5$, $2TeO_3+11H_2O$. Sol. in H_2O. (Weinland.)

Sodium arseniotellurate, $2Na_2O$, As_2O_5, $2TeO_3+9H_2O$.

Ppt. (Weinland, *l.c.*)

Arseniotungstic acid, $3H_2O$, As_2O_5, $16WO_3+32H_2O=H_3AsW_8O_{28}+16H_2O$ (α-anhydroarsenioluteotungstic acid).

Sol. in H_2O. (Kehrmann, A. **245.** 45.)

$3H_2O$, As_2O_5, $19WO_3$ (?). Sp. gr. of sat. solution in H_2O is 3.279. (Fremery, B. **17.** 296.)

Is a mixture containing principally $H_3AsW_8O_{28}+16H_2O$. (Kehrmann.)

As_2O_5, $18WO_3+xH_2O$. Sol. in H_2O. (Kehrmann, Z. anorg. 1899, **22.** 292.)

Aluminum ammonium arseniotungstate.

See **Aluminicoarseniotungstate, ammonium.**

Ammonium arseniotungstate, $4(NH_4)_2O$, $2H_2O$, As_2O_5, $6WO_3+3H_2O$.

Sl. sol. in cold H_2O or HNO_3+Aq; easily sol. in boiling H_2O. (Gibbs, Proc. Am. Acad. **16.** 135.)

$7(NH_4)_2O$, As_2O_5, $14WO_3$, $+17H_2O$. Very sl. sol. even in boiling H_2O. (Fremery, *l. c.*)

$3(NH_4)_2O$, As_2O_5, $16WO_3+16H_2O=(NH_4)_3AsW_8O_{28}+8H_2O$. Sol. in H_2O. (Kehrmann.)

$5(NH_4)_2O$, As_2O_5, $17WO_3+8H_2O$. Can be recryst. from H_2O without decomp. Decomp. by long boiling with H_2O. (Kehrmann, Z. anorg. 1899, **22.** 294.)

$3(NH_4)_2O$, As_2O_5, $18WO_3+14$, or $18H_2O$. Very sol. in cold H_2O. Can be recryst. from H_2O. (Kehrmann, *l.c.*)

$3(NH_4)_2O$, As_2O_5, $21WO_3+xH_2O$. Easily sol. in H_2O. Easily decomp. on recryst. (Kehrmann, *l.c.*)

$3(NH_4)_2O$, As_2O_5, $24WO_3+12H_2O$. More sol. in H_2O than corresponding phosphotungstate. (Kehrmann, *l.c.*)

Barium arseniotungstate, $2BaO$, As_2O_5, $16WO_3+xH_2O$.

Sol. in H_2O. (Péchard, A. ch. (6) **22.** 262.)

$7BaO$, As_2O_5, $22WO_3+54H_2O$. Sol. in H_2O. Can be recryst. therefrom. (Kehrmann, *l.c.*)

Potassium arseniotungstate, $3K_2O$, $3H_2O$, As_2O_5, $6WO_3$.

Insol. in H_2O. Readily sol. in alkali hydroxides+Aq. (Gibbs.)

$3K_2O$, As_2O_5, $16WO_3+16H_2O=K_3AsW_8O_{28}+8H_2O$. Sol. in H_2O. (Kehrmann.)

$5K_2O$, As_2O_5, $17WO_3+22H_2O$. Scarcely sol. in cold H_2O. (Kehrmann, Z. anorg. 1899, **22.** 295.)

$3K_2O$, As_2O_5, $18WO_3+14H_2O$. Efflorescent. (Kehrmann, *l.c.*)

$3K_2O$, As_2O_5, $19WO_3+16H_2O$ (?). Sol. in H_2O. (Fremery.)

Silver arseniotungstate, $Ag_5AsW_8O_{29}$.

Insol. in H_2O (Kehrmann, A. **245.** 55); perhaps identical with—

$6Ag_2O$, As_2O_5, $16WO_3+11H_2O$. Insol. in H_2O. (Gibbs.)

Sodium arseniotungstate, $3Na_2O$, As_2O_5, $3WO_3+20H_2O$.

Very sol. in H_2O. (Lefort, C. R. **92.** 1461.)

Arsenious acid, $HAsO_2$.

Solubility of $HAsO_2$ in amyl alcohol+Aq. at 25°.

a_w = mol. of $HAsO_2$ in 1 l. of H_2O.
a_a = mol. of $HAsO_2$ in 1 l. of amyl alcohol.
h = partition coefficient.

a_w	a_a	h
0.0449	0.0082	5.48
0.0446	0.0083	5.38
0.0887	0.0164	5 41
0.0892	0.0161	5.53
0.1800	0.0324	5.55

(Auerbach, Z. anorg. 1903, **37.** 356.)

Solubility of $HAsO_2$ in sat. H_3BO_3+Aq and amyl alcohol.

a_w = mol. of $HAsO_2$ in 1 l. of H_2O.
a_a = mol. of $HAsO_2$ in 1 l. of amyl alcohol.
h = partition coefficient.

a_w	a_a	h
0.0859	0.0161	5.33
0.1720	0.0321	5.35

(Auerbach, *l.c.*)

Insol. in ethyl acetate. (Naumann, B. 1904, **37.** 3601.)

See **Arsenic *tri*oxide.**

Arsenites.

All arsenites, except those of the alkali metals, are partially or wholly insol. in H_2O, but easily sol. in acids; several are sol. in $(NH_4)_2SO_4$, NH_4NO_3, or NH_4Cl+Aq.

All basic arsenites are sol. in acids except those that give an insol. salt with the bases. Many are sol. in excess of As_2O_3+Aq.

Aluminum arsenite, Al_2O_3, As_2O_3.

Sl. sol. in boiling H_2O. Easily sol. in NaOH +Aq and in acids. (Reichard, B. 1894, **27.** 1029.)

Aluminum arsenite iodide, AlI_3, $6As_2O_3+16H_2O$.

(Grühl, Dissert. **1897.**)

Ammonium arsenite, NH_4AsO_2.

Very sol. in H_2O. (Luynes, J. pr. **72.** 180.)

Insol. in acetone. (Eidmann, C. C. **1899**, II. 1014); (Naumann, B. 1904, **37.** 4328.)

$(NH_4)_3AsO_3$ (?). Sol. in H_2O. (Stavenhagen, J. pr. 1895, (2) **51.** 11.)

$(NH_4)_4As_2O_5$. Very sol. in H_2O. Insol. in alcohol or ether. (Stein, A. **74.** 218.)

Could not be obtained. (Stavenhagen.)

Ammonium arsenite bromide, $2As_2O_3$, NH_4Br.

Sl. sol. in H_2O. (Rüdorff, B. **19.** 2679.)

Ammonium arsenite chloride, As_2O_3, NH_4Cl.

Sl. sol. in H_2O. Sol. in warm dil. NH_4OH +Aq. (Rüdorff.)

Ammonium arsenite iodide, $2As_2O_3$, NH_4I.

Sl. sol. in boiling H_2O. Sol. in warm dil. NH_4OH+Aq. (Rüdorff.)

Antimony arsenite (?).

Ppt. Sol. in a small amount H_2O, but insol. in a large quantity. (Berzelius.)

Completely sol. in KOH+Aq. (Reynolds.)

Barium arsenite, $Ba(AsO_2)_2$.

Easily sol. in H_2O when recently pptd., but insol. after being dried. Pptd. from aqueous solution by boiling. (Filhol, A. **68.** 308.)

Only sl. sol. in H_2O. (Stavenhagen, J. pr. 1895, (2) **51.** 18.)

$Ba_3(AsO_3)_2$. Sl. sol. in cold H_2O; sol. in hot H_2O and dil. acids. (Stavenhagen, J. pr. 1895, (2) **51.** 17.)

$BaH_4(AsO_3)_2$. Ppt. (Bloxam, Chem. Soc. **15.** 281.)

$+34H_2O$. Moderately sol. in cold, more easily sol. in hot H_2O. Insol. in alcohol. (Perper, Dissert. **1894.**)

$Ba_2As_2O_5+2H_2O$. Easily sol. in H_2O. (Stavenhagen, J. pr. 1895, (2) **51.** 18.)

$+4H_2O$. Sl. sol. in H_2O; also somewhat sol. in alcohol. (Stein, A. **74.** 218.)

Sl. sol. in H_3AsO_4+Aq and BaO_2H_2+Aq. (Dumas.)

Sol. in NH_4Cl+Aq. (Wackenroder, A. **41.** 316.)

Not pptd. from solutions containing Na citrate. (Spiller.)

$BaAs_4O_7$. Sol. in H_2O. Less sol. in alcohol. (Reichard, B. 1894, **27.** 1033.)

Bismuth arsenite, $BiAsO_3+5H_2O$ (?).

Easily sol. in HNO_3+Aq. (Schneider, J. p. (2) **20.** 419.)

Sl. sol. in H_2O. (Stavenhagen, J. pr. 1895, (2) **51.** 35.)

Cadmium arsenite, $Cd_3(AsO_3)_2$.

Sl. sol. in H_2O; easily sol. in NH_4OH+Aq and dil. acids. (Stavenhagen, *l.c.*)

$Cd_2As_2O_5$. Ppt. (Reichard, B. 1898, **31.** 2168.)

Sol. in acids without decomp.; insol. in alkalis. (Reichard, B. 1894, **27.** 1033.)

$5CdO$, $As_2O_3+12H_2O$. Not attacked by KOH, $Ba(OH)_2$ or alkali carbonates+Aq. Insol. in KCN+Aq. (Reichard, Ch. Z. 1902, **26.** 1145.)

Cæsium arsenite bromide, As_2O_3, CsBr.

Sol. in H_2O. (Wheeler, Z. anorg. **4.** 451.)

Cæsium arsenite chloride, As_2O_3, CsCl.

As above.

Cæsium arsenite iodide, As_2O_3, CsI.

As above.

Calcium arsenite, $Ca(AsO_2)_2$.

Somewhat sol. in H_2O; sol. in $Ca(OH)_2$+Aq or As_2O_3+Aq. (Simon, Pogg. **47.** 417.)

$Ca_3(AsO_3)_2$. Ppt. (Kühn, J. B. **1852.** 379.)

Only sl. sol. H_2O; readily sol. in dil. acids. (Stavenhagen, *l.c.*)

Sol. in H_2O, insol. in alcohol. (Reichard, B. 1894, **27.** 1036.)

$3CaO$, $2As_2O_3+3H_2O$. Sl. sol. in H_2O; easily sol. in NH_4Cl+Aq; sol. in As_2O_3+Aq. (Stein.)

$CaH_4(AsO_3)_2+xH_2O$. Moderately sol. in H_2O. Insol. in abs. alcohol. (Perper, Dissert. **1894.**)

$Ca_2As_2O_5$. Sl. sol. in H_2O; 1 pt. in 3000–4000 pts. H_2O. Alkali chlorides increase solubility slightly. (Stavenhagen, *l.c.*)

Sl. sol. in H_2O; insol. in H_2O containing CaO_2H_2. (Berzelius.)

Not pptd. in presence of 4000–5000 pts. H_2O. (Harting, Lassaigne.)

Not pptd. from solutions containing NH_4 salts; and when pptd. is sol. in $(NH_4)_2SO_4$, NH_4NO_3, $NH_4C_2H_3O_2$, and NH_4Cl+Aq. (Gieseke and Schweigger.)

Sol. in NH_4AsO_2+Aq. (Schweigger.)

Sol. in $CaCl_2$+Aq. (Ordway.)

Easily sol. in dil. acids. Not pptd. from solutions containing sodium citrate. (Spiller.)

Calcium arsenite iodide, CaI_2, $3As_2O_3+12H_2O$.

Sl. sol. in H_2O. Decomp. on heating. (Grühl, Dissert. **1897.**)

Chromic arsenite, $CrAsO_3$.

Sol. in H_2O, but slowly decomp. by boiling. (Neville, C. N. **34.** 220.)

Sol. in HCl; repptd. by NH_4OH+Aq; sol. in KOH+Aq. (Reichard, B. 1894, **27.** 1028.)

Cobaltous arsenite basic, $7CoO$, As_2O_3.

Very sol. in dil., difficultly sol. in conc. H_2SO_4. Sol. in conc. NaOH and in conc. NH_4OH+Aq. (Reichard, Z. anal. 1903, **42.** 10.)

Cobaltous arsenite, $3CoO,As_2O_3$.

Sol. KOH+Aq with decomp. (Identical with salt of Girard). (Reichard, B. 1894, **27.** 1031.)

$+4H_2O$. Sl. sol. in H_2O; easily sol. in acids. (Stavenhagen, J. pr. 1895, (2) **51.** 39).

$3CoO, 2As_2O_3+4H_2O$. Sol. in HNO_3. (Girard, C. R. 1852, **34.** 918.)

$Co_3H_6(AsO_3)_4$. Insol. in H_2O; sol. in HNO_3, HCl, or NH_4OH+Aq. (Proust.)

Only sol. in KOH, or NaOH+Aq when formed in a solution containing an excess of those reagents. (Reynoso, C. R. **31.** 68.)

$Co_2As_2O_5$. Ppt. (Reichard, B. 1898, **31.** 2165.)

Sol. in HNO_3 and HCl+Aq. (Proust.)

Cupric arsenite, $Cu(AsO_2)_2$.

(Avery, J. Am. Chem. Soc. 1906, **28.** 1161.)

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 827.)

$+H_2O$. Sl. sol. in H_2O. (Stavenhagen, *l.c.*)

$+2H_2O$. Sl. sol. in H_2O; insol. in alcohol. (Stavenhagen, *l.c.*)

$3CuO, As_2O_3$. Ppt. (Stavenhagen, *l.c.*)

$2CuO,As_2O_3$. (Scheele's green.) Insol. in H_2O; sol. in KOH+Aq, NH_4OH+Aq, and in most acids. Formula is $Cu_3(AsO_3)_2+2H_2O$. (Sharples, C. N. **35.** 89.)

Sol. in NH_4OH+Aq without decomp. Sol. in KOH+Aq with decomp. (Reichard, B. 1894, **27.** 1026.)

Insol. in pyridine. (Schroeder, Dissert. **1901.**)

$5CuO, As_2O_3$. Insol. in H_2O, sol. in acids, NH_4OH+Aq and conc. MOH+Aq. (Reichard, Ch. Z. 1902, **26.** 1142.)

$xCuO, yAs_2O_3$. Min. *Trippkëite*. Easily sol. in HNO_3 and in HCl+Aq.

Didymium arsenite, $Di_2H_3(AsO_3)_3$.

Ppt. (Frerichs and Smith, A. **191.** 355.)

Does not exist. (Cleve, B. **11.** 910.)

Glucinum arsenite iodide, $GlI_2, 3As_2O_3+8H_2O$.

Decomp. by H_2O. (Grühl, Dissert. **1897.**)

Gold (aurous) arsenite, $3Au_2O,As_2O_3$.

Decomp. by light. (Reichard, B. 1894, **27.** 1027.)

Gold (auric) arsenite, $AuAsO_3+H_2O$.

Very sol. in H_2O, NH_4OH+Aq and dil. acids. (Stavenhagen, J. pr. 1895, (2) **51.** 28.)

Iron (ferrous) arsenite, FeO,As_2O_3.

Decomp. in the air when moist; sol. in NH_4OH+Aq when freshly pptd. (Reichard, B. 1894, **27.** 1029–30.)

$Fe_2As_2O_5$. Ppt. Sol. in NH_4OH+Aq; insol. in NH_4 arsenite, or other NH_4 salts+Aq. (Wittstein.)

Iron (ferric) arsenite, basic, $4Fe_2O_3, As_2O_3+5H_2O$.

Ppt. H_2O extracts As_2O_3. Sol. in conc. acids with separation of As_2O_3. Acetic acid is without action. (Bunsen and Berthold, **1834.**)

Sol. in KOH, or NaOH+Aq.

Iron (ferric) arsenite, Fe_2O_3,As_2O_3.

Sol. in NH_4OH+Aq when freshly pptd. (Reichard, B. 1894, **27.** 1030.)

$Fe_4As_2O_9$. Ppt. (Reichard, B. 1898, **31.** 2170.)

$+7H_2O$. Sol. in NaOH, and KOH+Aq.

"Ferric arsenite" is sl. sol. in $Al_2(SO_4)_3$+Aq. (Kynaston, Dingl. **235.** 326.)

Lanthanum arsenite, $La_2H_3(AsO_3)_3$.

Ppt. (Frerichs and Smith, A. **191.** 355.)

Does not exist. (Cleve, B. **11.** 910.)

Lead arsenite, $Pb(AsO_2)_2+xH_2O$.

Sl. sol. in H_2O. Insol. in KOH, but sol. in NaOH+Aq. (Berzelius.)

$Pb_2As_2O_5$. Insol. in H_2O, NH_4OH, NH_4 arsenite, or other NH_4 salts+Aq. (Wittstein.)

$Pb_3(AsO_3)_2$. Scarcely sol. in H_2O; easily sol. in HNO_3, or $HC_2H_3O_2$+Aq. Boiling H_2O dissolves some As_2O_3. Not completely insol. in KOH+Aq. (Streng, A. **129.** 238.)

Sol. in acetic acid; insol. in H_2O in the presence of ammonium salts; sol. in NaOH+Aq; sl. sol. in KOH+Aq. (Reichard, B. 1894, **27.** 1024.)

$+H_2O$. Sl. sol. in H_2O; easily sol. in dil. acids. (Stavenhagen, J. pr. 1895, (2) **51.** 33.

Lead arsenite chloride, $Pb_5As_2O_8, 2PbCl_2$.

Min. *Ekdemite*. Easily sol. in HNO_3+Aq, and warm HCl+Aq.

Magnesium arsenite, $Mg_3(AsO_3)_2$.

Insol. in NH_4OH+Aq, but sol. in a large excess of NH_4Cl+Aq. (Rose.)

Very sol. in boiling H_2O and in dil. acids. Sol. in NH_4Cl+Aq. (Reichard, B. 1894, **27.** 1032.)

Very sol. in H_2O and dil. acids. (Stavenhagen, *l.c.*)

$Mg_2As_2O_5+4H_2O$. Hydroscopic. Very sol. in H_2O and acids. (Stavenhagen, *l.c.*)

$3MgO,2As_2O_3+3H_2O$, $+15H_2O$, and $+18H_2O$. (Perper, Dissert. **1894.**)

Magnesium arsenite iodide, $MgI_2, 3As_2O_3+12H_2O$.

Moderately sol. in H_2O. (Grühl, Dissert. **1897.**)

Manganous arsenite, $Mn_3(AsO_3)_2+3H_2O$.

Sol. in H_2O; insol. in alcohol; easily oxidized by moist air. (Stavenhagen, *l.c.*)

$3MnO,2As_2O_3$. (Reichard, B. 1894, **27.** 1032.)

$Mn_3H_2As_4O_{10}+4H_2O$. Sl. sol. in H_2O. Very sol. in acids and alkali. (Stavenhagen, *l.c.*)

$Mn_5As_2O_8$. Ppt. (Reichard, B. 1898, **31.** 2165.)

Mercurous arsenite, Hg_2O,As_2O_3.

Decomp. by light. Decomp. by H_2O. (Reichard, B. 1894, **27.** 1022.)

Hg_3AsO_3. Only sl. sol. in H_2O; sol. in dil. acids. (Stavenhagen, J. pr. 1895, (2) **51.** 24.)

Gradually and completely decomposed by H_2O. (Reichard, Ch. Z. 1902, **26.** 1143.)

Mercuric arsenite, $Hg_3(AsO_3)_2$.

Sl. sol. in H_2O. (Stavenhagen, *l.c.*)

Decomp. more easily by H_2O than is the mercurous comp. (Reichard, Ch. Z. 1902, **26.** 1143.)

$2HgO,As_2O_3$. Not decomp. by boiling with H_2O. Undecomp. by boiling acids. Decomp. by KOH+Aq, K_2CO_3+Aq and NH_4OH+Aq. (Reichard, B. 1894, **27.** 1021.)

$Hg_5As_2O_8$. Ppt. Decomp. by boiling H_2O. Very sl. sol. in H_2SO_4+HCl. (Reichard, B. 1898, **31.** 2170.)

Nickel arsenite, $Ni_3(AsO_3)_2$.

Insol. in H_2O; easily sol. in NH_4OH+Aq (Proust.)

Ppt. (Reichard, B. 1898, **31.** 2165.)

$3NiO,2As_2O_3$. Sol. in NH_4OH+Aq (identical with salt of Girard). (Reichard, B. 1894, **27.** 1031.)

$+4H_2O$. Insol. in H_2O; sol. in NH_4OH+Aq. (Proust.)

Sol. in KOH+Aq. (Girard, C. R. **34.** 918.)

$2NiO, As_2O_3$. Insol. in H_2O; sol. in NH_4OH+Aq; sol. in KOH+Aq. (Reynoso, C. R. **31.** 68.)

Platinum arsenite, $Pt_3(AsO_3)_4$.

Sol. in H_2O and alcohol; very unstable. (Stavenhagen, *l.c.*)

Potassium arsenite, $KAsO_2$.

Sol. in H_2O; sl. sol. in alcohol. (Pasteur, A. **68.** 309.)

Insol. in ethyl acetate. (Naumann, B. 1904, **37.** 3601.)

Does not exist. (Stavenhagen, *l.c.*)

K_3AsO_3. Very sol. in H_2O; sol. in alcohol. (Stavenhagen, *l.c.*)

$K_4As_2O_5+6H_2O$. Very sol. in H_2O; sol. in alcohol. (Stavenhagen, *l.c.*)

$K_2As_4O_7+2H_2O$. Sol. in H_2O; sl. sol. in alcohol. (Pasteur, A. **68.** 309.)

Potassium arsenite bromide, $4As_2O_3$, 2KBr.

More sol. in H_2O than iodide. (Schiff and Sestini, A. **228.** 72.)

$2As_2O_3$, KBr. (Rüdorff, B. **19.** 2675.)

Potassium arsenite chloride, $2As_2O_3$, KCl.

Much more quickly sol. in hot H_2O than bromide or iodide. (Rüdorff, B. **19.** 2675.)

As_2O_3, KCl. Decomp. by H_2O.

Potassium arsenite iodide, $3As_2O_3$, $2KI+H_2O$.

Sl. sol. in cold H_2O; sol. in 20 pts. boiling, and 40 pts. cold H_2O. (Emmet, Sill. Am. J. (2) **18.** 583.)

$6KAsO_2$, $2KI+3H_2O$. Sol. in H_2O and alcohol. Decomp. by acids. (Harms.)

$2KH(AsO_2)_2$, As_2O_3, 2KI. Sl. sol. in H_2O. (Harms, A. **91.** 371.)

$2As_2O_3$, KI. Very difficultly sol. even in boiling H_2O. Very easily sol. in KOH+Aq, but much less so in K_2CO_3+Aq. (Rüdorff, B. **19.** 2670.)

Sol. in 40 pts. cold, 20 pts. hot H_2O; sol. in alkalies. (Schiff and Sestini, A. **228.** 72.)

Potassium arsenite sulphate, K_3AsO_3, $10K_2SO_4$.

(Stavenhagen, Zeit. angew. ch. 1894, **8.** 166.)

Rubidium arsenite, $RbAsO_2$.

Sol. in H_2O; aq. solution is alkaline to litmus. Insol. in alcohol. (Bouchonnet, C. R. 1907, **144.** 641.)

Rubidium arsenite bromide, As_2O_3, RbBr.

Decomp. by H_2O. (Wheeler, Z. anorg. **4.** 451.)

Rubidium arsenite chloride, As_2O_3, RbCl.

As above.

Rubidium arsenite iodide, As_2O_3, RbI.

As above.

Silver arsenite, Ag_3AsO_3.

Insol. in H_2O. Not pptd. in presence of 20,000 pts. H_2O. (Harting.)

1 l. H_2O dissolves 0.0115 g. Ag_3AsO_3 at 20°. (Whitby, Z. anorg. 1910, **67.** 108.)

Only sl. sol. in H_2O and in dil. acids; readily sol. in NH_4OH+Aq and conc. acids. (Stavenhagen, *l.c.*)

Decomp. by light, by KOH+Aq and by NH_4OH+Aq. (Reichard, B. 1894, **27.** 1022–23.)

Easily sol. in HNO_3+Aq and other acids. (Marcet.)

More easily sol. in $HC_2H_3O_2$+Aq than Ag_3PO_4; sl. sol. in $HC_2H_3O_2$+Aq. (Santos, C. N. **38.** 94.)

Insol. in KOH+Aq. (Kühn, Arch. Pharm. (2) **69.** 267.)

Easily sol. in NH_4OH+Aq. (Marcet.)

Insol. in NH_4OH+Aq, but sol. therein in presence of alkali nitrates. (Santos, *l.c.*)

Incompletely sol. in $(NH_4)_2CO_3$, $(NH_4)_2SO_4$, or NH_4NO_3+Aq. (Wittstein, Repert. **51.** 41.)

Decomp. by NH_4Cl+Aq. Sol. in $KAsO_2$+Aq. (Kühn, *l.c.*)
Not pptd. in solutions containing sol. citrates. (Spiller.)
Sol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)
Sl. sol. in methyl acetate. (Bezold, Dissert. **1908.**)
Insol. in ethyl acetate. (Hamers, Dissert. **1906**); (Naumann, B. 1910, **43.** 314.)
$+H_2O$. Very sol. in H_2O, NH_4OH+Aq and in dil. acids. (Stavenhagen, J. pr. 1895, (2) **51.** 29.)
$2Ag_2O, As_2O_3$. Ppt. (Pasteur, J. Pharm. (3) **13.** 395.)
Could not be obtained. (Stavenhagen, *l.c.*)
$3Ag_2O, 2As_2O_3$. Sol. in cold $HC_2H_3O_2$+Aq. (Santos.)
Sol. in NH_4OH+Aq and in potassium arsenite+Aq. (Girard, C. R. **34.** 918.)
Ppt. (Reichard, B. 1898, **31.** 2167.)
Could not be obtained. (Stavenhagen, *l.c.*)

Silver arsenite ammonia, $2Ag_2O, As_2O_3, 4NH_3$.

Insol. in H_2O or alcohol. (Girard.)

Sodium arsenites.

Correspond to potassium arsenites, but have not been obtained in crystalline form. All are very sol. in H_2O. (Pasteur, A. **68.** 308.
Na_3AsO_3. Very sol. in H_2O. (Stavenhagen, *l.c.*)
Insol. in ethyl acetate. (Naumann, B. 1904, **37.** 3602.)

Sodium arsenite bromide, $2As_2O_3, NaBr$.

Decomp. by warm H_2O. (Rüdorff, B. **21.** 3052.)

Sodium arsenite iodide, $2As_2O_3, NaI$.

Decomp. by hot H_2O. (Rüdorff.)

Strontium arsenite, $Sr_3(AsO_3)_2$.

Sol. in H_2O. (Stavenhagen, *l.c.*)
Sol. in H_2O, insol. in alcohol (identical with Stein). (Reichard, B. 1894, **27.** 1036.)
$Sr_2As_2O_5+2H_2O$. Quite easily sol. in H_2O. (Stein.)
Sl. sol. in H_2O, SrO_2H_2+Aq, or H_3AsO_4+Aq. (Dumas.)
Very sl. sol. in alcohol. (Stein.)
Easily sol. in H_2O and in acids. (Stavenhagen, J. pr. 1895, (2) **51.** 17.)
$Sr_3As_4O_9$. Moderately sol. in H_2O. (Reichard, B. 1894, **27.** 1036.)

Strontium arsenite iodide, $SrI_2, 3As_2O_3+12H_2O$.

As Ba comp. (Grühl, Dissert. **1897.**)

Thallium arsenite, Tl_3AsO_3.

Sl. sol. in H_2O and alcohol; easily sol. in acids, especially in dil. H_2SO_4. (Stavenhager, *l.c.*)

Tin (stannous) arsenite, $Sn_3(AsO_3)_2$.

Ppt.; decomp. by acids and alkali. (Reichard, B. 1898, **31.** 2169.)
$+2H_2O$. Sl. sol. in H_2O. Easily sol. in dil. acids and alkalies. (Stavenhagen, *l.c.*)

Tin (stannic) arsenite, $Sn_3(AsO_3)_4+5\frac{1}{2}H_2O$.

Sl. sol. in H_2O. (Stavenhagen, *l.c.*)
$5SnO_2, 2As_2O_3$. Ppt. Sol. in acids without decomp. (Reichard, B. 1894, **27.** 1025.)
$Sn_7As_2O_{17}$. Ppt. (Reichard, B. 1898, **31.** 2169.)

Uranium arsenite, UO_2, As_2O_3.

Insol. in NH_4OH+Aq; only sl. sol. KOH+Aq. Sol. in acids. (Reichard, B. 1894, **27.** 1029.)

Zinc arsenite, ZnO, As_2O_3.

Ppt. (Avery, J. Am. Chem. Soc. 1906, **28.** 1163.)
$3ZnO,As_2O_3$. Sol. in acids without decomp. Easily sol. in NH_4OH+Aq. (Reichard, B. 1894, **27.** 1033.)

Arseniovanadic acid, $As_2O_5, V_2O_5+2H_2O$.

Easily sol. in H_2O, but solution easily decomposes; crystallizes from H_2O with $10H_2O$. Composition is vanadium dihydrogen arsenate $(VO_2)H_2AsO_4$. (Friedheim, B. **23.** 2600.)
+14, and $+18H_2O$. (Ditte, C. R. **102.** 757.) Could not be obtained. (Friedheim.)
$3As_2O_5, 2V_2O_5$. (Berzelius.) Correct formula is as above. (Friedheim.)
$3H_2O, 7As_2O_5, 6V_2O_5$. (Gibbs, Am. Ch. J. **7.** 209.) Could not be obtained. (Friedheim.)
$3H_2O, 5As_2O_5, 8V_2O_5+24H_2O$. (Gibbs.) Could not be obtained. (Friedheim.)

Arseniovanadates.

According to Friedheim (Z. anorg. 1892, **2.** 319) the arseniovanadates are double arsenates of VO_2 and NH_4.

Ammonium arseniovanadate, $(NH_4)_2O, As_2O_5\ 2V_2O_5,+5H_2O$.

Efflorescent in dry air; sl. sol. in cold, decomp. by hot H_2O. Composition is ammonium divanadium arsenate $=(VO_2)_2(NH_4)AsO_4+2\frac{1}{2}H_2O$. (Friedheim, B. **23.** 2600.)
Sl. sol. in cold H_2O. Somewhat more easily sol. in hot H_2O with separation of V_2O_5. (Schmitz-Dumont, Dissert. **1891.**)
$2(NH_4)_2O, 3As_2O_5\ 2V_2O_5,+4H_2O$. Cannot be crystallized from H_2O. Composition is $(NH_4)_2HAsO_4+2(VO_2)_2H_2AsO_4$. (Friedheim.)
Decomp. under H_2O to $(NH_4)_2O, 2V_2O_5$. $As_2O_5+5H_2O$. (Schmitz-Dumont, *l.c.*)
$5(NH_4)_2O, 4As_2O_5, 2V_2O_5+18H_2O$. Sol. in H_2O. (Ditte, C. R. **102.** 1019.) Does not exist. (Friedheim, B. **23.** 2605.)

Calcium arseniovanadate, $2CaO, 3As_2O_5, 2V_2O_5+21H_2O=CaHAsO_4+2(VO_2)H_2AsO_4+8H_2O$.

Can be crystallized in presence of vanadic acid without decomp. (Friedheim.)

Efflorescent. Sol. in H_2O. (Schmitz-Dumont, *l.c.*)

Cobalt arseniovanadate, $CoO, As_2O_5, V_2O_5+9H_2O=Co(VO_2)_2H_2(AsO_4)_2+8H_2O$.

Sol. in H_2O. (Friedheim.)

Copper arseniovanadate, $CuO, As_2O_5, V_2O_5+4H_2O=Cu(VO_2)_2H_2(AsO_4)_2+3H_2O$.

Sol. in H_2O. (Friedheim.)

Magnesium arseniovanadate, $MgO, As_2O_5, V_2O_5+10H_2O=(VO_2)_2MgH_2(AsO_4)_2+9H_2O$.

Sol. in H_2O. (Friedheim.)

Moderately sol. in H_2O. Solution decomp. on standing. (Schmitz-Dumont, *l.c.*)

$2MgO, 3As_2O_5 2V_2O_5,+23H_2O=MgHAsO_4+2(VO_2)H_2AsO_4+9H_2O$. Sol. in H_2O. (Friedheim.)

Sol. in H_2O but solution decomp. on evaporation. (Schmitz-Dumont, *l.c.*)

Potassium arseniovanadate, $K_2O, As_2O_5, 2V_2O_5+5H_2O=(VO_2)_2KAsO_4+2\frac{1}{2}H_2O$.

Sol. in H_2O. (Friedheim.)

Sl. sol. in cold H_2O. Partially decomp. on heating. (Schmitz-Dumont.)

Strontium arseniovanadate, $2SrO, 3As_2O_5, 2V_2O_5+20H_2O=SrHAsO_4+2(VO_2)_2H_2AsO_4+7\frac{1}{2}H_2O$.

Sol. in H_2O. (Friedheim.)

$+21H_2O$. Easily sol. in H_2O. (Schmitz-Dumont.)

Zinc arseniovanadate, $ZnO, As_2O_5, V_2O_5+6\frac{1}{2}H_2O=Zn(VO_2)_2H_2(AsO_4)_2+5\frac{1}{2}H_2O$.

Sol. in H_2O. (Friedheim.)

$2ZnO, 3As_2O_5, 2V_2O_5+5H_2O$, and $+18H_2O=ZnHAsO_4+2(VO_2)_2H_2AsO_4$, and $+6\frac{1}{2}H_2O$. Sol. in H_2O. (Friedheim.)

Arseniovanadicotungstic acid.

Ammonium arseniovanadicotungstate, $17(NH_4)_2O, 2As_2O_5, 14\frac{1}{2}V_2O_3, 29WO_3+98H_2O$.

Sl. sol. in cold H_2O. Readily sol. in boiling H_2O. Insol. in alcohol, ether, benzene, CS_2, $CHCl_3$, acetone, nitrobenzene, aniline and acetic anhydride. (Rogers, J. Am. Chem. Soc. 1903, **25.** 307.)

Arseniovanadicovanadic acid.

Ammonium arseniovanadicovanadate, $5(NH_4)_2O, 12As_2O_5, 12VO_2, 6V_2O_5+7H_2O$.

Sl. sol. in cold, sol. in hot H_2O, from which crystallizes—

$4(NH_4)_2O, 9As_2O_5, 9VO_2, 8V_2O_5+11H_2O$. Sol. in H_2O. (Gibbs, Am. Ch. J. **7.** 209.)

Arseniovanadicovanadiotungstic acid.

Ammonium arseniovanadicovanadiotungstate, $17(NH_4)_2O, 2As_2O_5, 7V_2O_5, 4V_2O_3, 32WO_3+73H_2O$.

Sl. sol. in cold, readily sol. in boiling H_2O. (Rogers, J. Am. Chem. Soc. 1903, **25.** 310.)

Arseniovanadiotungstic acid.

Ammonium arseniovanadiotungstate, $18(NH_4)_2O, 2As_2O_5, 13V_2O_5, 39WO_3+88H_2O$.

Sol. in H_2O. Insol. in organic solvents. (Rogers, J. Am. Chem. Soc. 1903, **25.** 306.)

Arseniuretted hydrogen, AsH_3.

See **Arsenic hydride.**

Arsenochromic acid.

Potassium arsenochromate, $K_4Cr_2As_2O_{16}+12H_2O$.

Sol. in moderately conc. mineral acids. (Tarugi, C. C. **1897,** II. 724.)

$K_7Cr_3As_5O_{22}+24H_2O$. Ppt. Sol. in dil. warm acids. (Tarugi.)

Potassium hydrogen arsenochromate, $K_4H_6Cr_3As_2O_{16}$.

(Tarugi, C. C. **1897,** II. 724.)

Arsenosoarseniotungstic acid.

Potassium arsenosoarseniotungstate, $10K_2O, 4As_2O_5, As_2O_3, 21WO_3+26H_2O$.

Precipitate. Sol. in a large amount of hot H_2O. (Gibbs, Am. Ch. J. **7.** 313.)

Arsenosomolybdic acid.

Ammonium arsenosomolybdate, $3(NH_4)_2O, 5As_2O_3, 12MoO_3+24H_2O$.

Sl. sol. in H_2O. (Gibbs, Am. Ch. J. **7.** 313.)

Ammonium barium arsenosomolybdate, $3(NH_4)_2O, 2BaO, 5As_2O_3, 10MoO_3+50H_2O$.

Ppt. (Ephraim, Z. anorg. 1910, **66.** 57.)

Ammonium cupric arsenosomolybdate, $(NH_4)_2O, CuO, 2As_2O_3, 4MoO_3+2H_2O$, and $2(NH_4)_2O, CuO, 3As_2O_3, 6MoO_3+13H_2O$.

Ppts. (Ephraim, Z. anorg. 1910, **66.** 58.)

Barium arsenosomolybdate, $3BaO, 2As_2O_3, 8MoO_3+13H_2O$.

Very sl. sol. in H_2O. (Gibbs.)

Copper arsenosomolybdate, $2CuO, 3As_2O_3, 6MoO_3$.

Sol. in H_2O. (Gibbs.)

Manganese arsenosomolybdate, $2MnO, 3As_2O_3, 6MoO_3+6H_2O$, and $+15H_2O$.

Insol. in H_2O. (Gibbs.)

Potassium arsenosomolybdate, $3K_2O, As_2O_3, 5MoO_3+3H_2O$.

Easily sol. in H_2O. (Ephraim, Z. anorg. 1910, **66.** 54.)

$3K_2O, As_2O_3, 8MoO_3+18H_2O$. Easily sol. in H_2O. (Ephraim.)

Sodium arsenosomolybdate, $Na_2O, As_2O_3, 2MoO_3+6H_2O$.

Easily sol. in H_2O. (Ephraim, Z. anorg. 1910, **66.** 56.)

$2Na_2O, As_2O_3, 4MoO_3+13H_2O$. Ppt. (Ephraim.)

Zinc arsenosomolybdate, $2ZnO, 3As_2O_3, 6MoO_3+6H_2O$.

Sol. in H_2O. (Gibbs.)

Arsenosophosphotungstic acid.

Potassium arsenosophosphotungstate, $10K_2O, 14As_2O_3, 3P_2O_5, 32WO_3+28H_2O$.

Moderately sol. in cold, very easily in hot H_2O. (Gibbs.)

$7K_2O, 2As_2O_3, 4P_2O_5, 60WO_3+55H_2O$. Sol. in hot H_2O with decomp. (Gibbs.)

Potassium sodium arsenosophosphotungstate, $5K_2O, Na_2O, 2As_2O_3, 2P_2O_5, 12WO_3+15H_2O$.

(Gibbs, Am. Ch. J. **7.** 313.)

Arsenosotungstic acid.

Ammonium arsenosotungstate, $7(NH_4)_2O, 2As_2O_3, 18WO_3+18H_2O$.

Sol. in H_2O. (Gibbs.)

Barium arsenosotungstate, $4BaO, As_2O_3, 9WO_3+21H_2O$.

Precipitate. Nearly insol. in H_2O. (Gibbs.)

Sodium arsenosotungstate, $9Na_2O, 8As_2O_3, 16WO_3+55H_2O$.

Very sol. in H_2O. (Gibbs, Am. Ch. J. **7.** 313.)

Arsenyl bromide, $AsOBr$.

H_2O dissolves out As_2O_3; insol. in alcohol. (Sérullas.)

$+H_2O$. (Wallace, Phil. Mag. (4) **17.** 122.)

$As_8O_9Br_6=2AsBr_3, 3As_2O_3+12H_2O$.

Arsenyl bromide *with* MBr.

See **Arsenite bromide, M.**

Arsenyl chloride, $AsOCl$.

Sol. in H_2O with decomp.

$+H_2O$. (Wallace, Phil. Mag. (4) **16.** 358.)

As_3O_4Cl. (Wallace.)

Arsenyl chloride *with* MCl.

See **Arsenite chloride, M.**

Arsenyl potassium fluoride, $AsOF_3, KF+H_2O$.

(Marignac, A. **145.** 237.)

Arsenyl iodide, $As_8I_2O_{11}=2AsOI, 3As_2O_3+12H_2O$.

Decomp. by H_2O. (Wallace, Phil. Mag. (4) **17.** 122.)

Sl. sol. in cold H_2O, less sol. in alcohol. (Plisson, J. Pharm. **14.** 46.)

Arsenyl iodide *with* MI.

See **Arsenite iodide, M.**

Arsenyl sulphoiodide, $As_{13}I_9S_6O_9$.

Scarcely attacked by cold H_2O. Boiling H_2O extracts AsI_3. Decomp. by hot HNO_3 or H_2SO_4. Easily sol. in KOH, or NH_4OH+Aq. (Schneider, J. pr. (2) **36.** 513.)

Arsine.

See **Arsenic hydride.**

Atmospheric air.

See **Air, atmospheric.**

Auriamine, $Au(OH)_2NH_2$.

(Jacobsen, C. R. 1908, **146.** 1214.)

***Di*auriamine,** $Au_2(OH)_4NH$.

(Jacobsen, C. R. 1908, **146.** 1214.)

***Sesqui*auriamine,** NAu_3, NH_3.

Decomp. by H_2O into NAu_3. (Raschig, A. **235.** 341.)

Auric acid, HAu_2O_4.

Sol. in HBr, or HCl+Aq. (Krüss, B. **19.** 2546.)

Ammonium aurate.

See **Auroamidoimide.**

Barium aurate, $BaAu_2O_4+5H_2O$.

Sl. sol. in H_2O. (Weigand, Zeit. angew. Ch. 1905, **19.** 139.)

$+6H_2O$. Sl. sol. in H_2O. Sol. in dil. H_2SO_4 and in dil. HNO_3. Sol. in HCl. Decomp. by alcohol. (Meyer, C. R. 1907, **145.** 806.)

Calcium aurate (?).

Insol. in H_2O; sol. in $CaCl_2$+Aq. (Fremy, A. ch. (3) **31.** 485.)

$CaAu_2O_4+6H_2O$. As Ba salt. (Meyer, C. R. 1907, **145.** 806.)

Magnesium aurate (?).

Ppt. Insol. in H_2O; sol. in $MgCl_2$+Aq. (Pelletier.)

Potassium aurate, $KAuO_2+3H_2O$.

Very sol. in H_2O, and easily decomp. (Fremy, A. ch. (3) **31.** 483.)

Sol. in alcohol; the solution in alcohol does not decomp. below 50°. (Figuier, A. ch. (3) **11.** 364.)

Potassium aurate sulphite, $KAuO_2, 2K_2SO_3+5H_2O$.

Sol. in H_2O with decomp. Nearly insol. in alkaline solutions. (Fremy, A. ch. (3) **31.** 485.)

Sodium aurate, $Na_2Au_2O_4+2H_2O$.

Sol. in H_2O. Sol. in dil. H_2SO_4, dil. HNO_3, and HCl with decomp. Decomp. by alcohol. (Meyer, C. R. 1907, **145.** 806.)

Strontium aurate, $SrAu_2O_4+6H_2O$.

As Ba salt. (Meyer.)

Auriimide chloride, Au(NH)Cl.

(Raschig.)

Auriimide nitrate, $Au_2N_2H_2O$, $2HNO_3$, or AuN, $HNO_3+\frac{1}{2}H_2O$, or $Au_2O(NH)_2$, $2HNO_3$.

Not deliquescent. Decomp. by hot H_2O into $Au_2O(NH)_2$. (Schottländer, J. B. **1884.** 453.)

Auroamidoimide, $Au(HN)NH_2+3H_2O$.

(Fulminating gold.) Insol. in H_2O; not attacked by dil. acids; sol. in conc. acids, and in moderately dil. acids, when freshly precipitated. Insol. in alkalies or alcohol. Sol. in KCN+Aq.

*Tri***auroamine**, Au_3N+5H_2O.

Not decomp. by boiling dil. acetic acid, HNO_3, or H_2SO_4. (Raschig, A. 1886, **235.** 349.)

Auricyanhydric acid, $HAu(CN)_4+1\frac{1}{2}H_2O$.

Easily sol. in H_2O, alcohol, or ether.

See also **Bromauricyanides.**
Chlorauricyanides.
Iodauricyanides.

Ammonium auricyanide, $NH_4Au(CN)_4$.

Easily sol. in H_2O or alcohol. Insol. in ether.

Cobaltous auricyanide, $Co[Au(CN)_4]_2+9H_2O$.

Sl. sol. in cold, easily in hot H_2O. Sl. sol. in alcohol. (Lindbom.)

Potassium auricyanide, $KAu(CN)_4+1\frac{1}{2}H_2O$.

Efflorescent. Sl. sol. in cold, easily in hot H_2O. Easily sol. in alcohol.

Silver auricyanide, $AgAuCN_4$.

Insol. in H_2O or HNO_3+Aq. Sol. in NH_4OH+Aq.

*Di***auro***di***amine nitrate.**

See **Auriimide nitrate.**

Aurobromhydric acid.

See **Bromauric acid.**

Aurobromic acid.

See **Bromauric acid.**

Aurochlorhydric acid.

See **Chlorauric acid.**

Aurochloric acid.

See **Chlorauric acid.**

Aurocyanhydric acid.

Aurocyanides with MCN.

See **Cyanide, aurous with MCN.**

Azinosulphonic acid.

Ammonium azinosulphonate, $N_3SO_3NH_4$.

(Traube, B. 1914, **47.** 944.)

Barium azinosulphonate, $(N_3SO_3)_2Ba$.

(Traube, B. 1914, **47.** 944.)

Potassium azinosulphonate, N_3SO_3K.

Easily sol. in H_2O. Can be cryst. from boiling abs. alcohol. (Traube, B. 1914, **47.** 943.)

Sodium azinosulphonate, N_3SO_3Na.

(Traube, B. 1914, **47.** 944.)

Azoimide, HN_3.

Miscible with H_2O and alcohol. (Curtius and Radershausen, J. pr. (2) **43.** 207.)

Stable in aq. solution; decomp. slowly by dil. boiling HCl. (Curtius, J. pr. 1898, (2) **58.** 265.)

For salts of HN_3, see azoimide of metal under metal.

Azoimide, hydroxylamine, $N_3H,2NH_2OH$.

Sol. in H_2O. Gradually volatilizes at ord. temp. (Dennis, J. Am. Chem. Soc. 1907, **29.** 22.)

Azophosphoric acid.

*See Pyro***phosphamic acid.**

*Deut***azophosphoric acid.**

*See Pyro***phospho***di***amic acid.**

Barium, Ba.

Decomp. by H_2O and abs. alcohol. (Guntz, C. R. 1901, **133.** 874.)

Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 827.)

Barium amalgam, $BaHg_{13}$.

Stable in contact with liquid amalgam up to 30°. Can be cryst. from Hg without decomp. if temp. does not exceed 30°. (Kerp, Z. anorg. 1900, **25.** 68.)

$BaHg_{12}$. Stable in contact with liquid amalgam from 30°–100°. Can be cryst. from Hg without decomp. at any temp. within these limits. (Kerp.)

Barium amide, $Ba(NH_2)_2$.

B.-pt. 280°. (Mentrel, C. C. **1903**, I. 276.)

Decomp. by H_2O. (Guntz and Mentrel, Bull. Soc. 1903, (3) **29.** 578.)

Barium potassium amide.

See **Potassium ammonobarate.**

Barium ammonia, $Ba(NH_3)_6$.

Takes fire in the air. Only sl. sol. in liquid NH_3. Violently decomp. by H_2O. (Mentrel, C. R. 1902, **135.** 740.)

Barium arsenide, Ba_3As_2.

Decomp. by H_2O. (Lebeau, C. R. 1899, **129.** 48.)

Barium azoimide, $Ba(N_3)_2$.

Very sl. hydroscopic; explosive.

12.5 pts. are sol. in 100 pts. H_2O at 0°
16.2 " " " " 100 " H_2O " 10.5°
16.7 " " " " 100 " H_2O " 15°
17.3 " " " " 100 " H_2O " 17°

0.0172 pts. are sol. in 100 pts. abs. alcohol at 16°.

Insol. in ether. (Curtius, J. pr. 1898, (2) **58.** 290.)

See also **Barium nitride.**

Barium boride, BaB_6

Sol. in fused oxidizing agents, not decomp. by H_2O; insol. in aq. acids; sl. sol. in conc. H_2SO_4, sol. in dil. and conc. HNO_3. (Moissan, C. R. 1897, **125,** 634.)

Barium ***sub*****bromide sodium bromide,** BaBr, NaBr.

Decomp. by H_2O. (Guntz, C. R. 1903, **136.** 750.)

Barium bromide, $BaBr_2$, and $+2H_2O$.

100 pts. H_2O dissolve—

at	0°	20°	40°	60°	80°	100°
	98	104	114	123	135	149 pts. $BaBr_2$.

Sat. $BaBr_2$+Aq contains at:

—20°	—9°	+7°	16°	19°	40°	
45.7	46.5	48.5	48.8	49.3	50.9%$BaBr_2$	
71°	76°	77°	104°	145°	160°	175°
55.1	55.5	55.6	56.6	60.5	59.4	60.3%$BaBr_2$

(Étard, A. ch. 1894, (7) **2.** 540.)

Sp. gr. of $BaBr_2$+Aq at 19.5° containing:

5	10	15	20	25	30%$BaBr_2$
1.045	1.092	1.114	1.201	1.262	1.329
35	40	45	50	55%$BaBr_2$.	
1.405	1.485	1.580	1.685	1.800	

(Kremers, Pogg. **99.** 444, calculated by Gerlach, Z. anal. **8.** 285.)

$BaBr_2$+Aq containing 7.74% $BaBr_2$ has sp. gr. 20°/20°=1.0716.

$BaBr_2$+Aq containing 16.76% $BaBr_2$ has sp. gr. 20°/20°=1.1674.

(Le Blanc and Rohland, Z. phys. Ch. 1896, **19.** 279.)

Sat. $BaBr_2$+Aq boils at 113°. (Kremers, Pogg. **99.** 43.)

Solubility in BaI_2+Aq at t°.

t°	Sat. solution contains	
	% $BaBr_2$	% BaI_2
—16	4.7	57.9
—16	5.0	59.0
+60	5.5	66.0
135	9.3	67.3
135	9.0	67.2
170	11.0	67.4
210	14.9	67.7

(Étard, A. ch. 1894, (7) **3.** 287.)

Very sol. in absolute alcohol. (Hünefeld.)

100 pts. absolute methyl alcohol dissolve 50 pts. $BaBr_2$ at 22.5°.

100 pts. absolute ethyl alcohol dissolve 3 pts. $BaBr_2$ at 22.5°. (de Bruyn, Z. phys. Ch. **10.** 783.)

Sat. solution in 87% alcohol contains 6% $BaBr_2$. (Richards, Z. anorg. **3.** 455.)

100 pts. absolute methyl alcohol dissolve 45.8 pts. $BaBr_2+2H_2O$ at 15°.

100 pts. 93.5% methyl alcohol dissolve 27.3 pts. $BaBr_2+2H_2O$ at 15°.

100 pts. 50% methyl alcohol dissolve 4 pts. $BaBr_2+2H_2O$ at 15°. (de Bruyn, Z. phys. Ch. **10.** 787.)

100 g. $BaBr_2+CH_3OH$ contain 0.4 g. $BaBr_2$ at the critical temp. (Centnerszwer, Z. phys. Ch. 1910, **72.** 437.)

At 15°, 1 pt. by weight is sol. in:

36 pts. methyl alcohol, sp. gr. 0.709
207 " ethyl " " " 0.8035
652 " propyl " " " 0.8085

(Rohland, Z. anorg. 1897, **15.** 413.)

Nearly insol. in boiling amyl alcohol, 10 ccm. dissolving only an amt. equal to 1.3 mg BaO. (Browning, Sill. Am. J. **144.** 459.)

Sol. in acetone. (Naumann, B. 1904, **37.** 4328; Eidmann, C. C. **1899,** II. 1014.)

Insol. in benzonitrile. (Naumann, B. 1914, **47.** 1370.)

Difficultly sol. in methyl acetate. (Naumann, B. 1909, **42.** 3789.)

Insol. in ethyl acetate. (Naumann, B. 1910, **43.** 314.)

Barium cadmium bromide, $BaBr_2$, $CdBr_2+4H_2O$.

Sol. in H_2O. (v. Hauer, W. A. B. **20.** 40.)

Barium rhodium bromide.

See **Bromorhodite, barium.**

Barium bromide ammonia, $BaBr_2,8NH_3$.

Decomp. by H_2O. (Joannis, C. R. 1905, **140.** 1244.)

Barium bromide hydrazine, $BaBr_2$, $2N_2H_4$.

Hydroscopic. Very sol. in H_2O. Insol. in alcohol. (Franzen, Z. anorg. 1908, **60.** 291.)

Barium bromofluoride, $BaBr_2,BaF_2$.

Insol. in and undecomp. by boiling alcohol. Sol. in HBr and in HNO_3. Decomp. by H_2O, hot H_2SO_4, dil. HCl, dil. HNO_3, or dil. acetic acid. (Defacqz, C. R. 1904, **138.** 199.)

Barium carbide, BaC_2.

Decomp. by H_2O. (Maquenne, C. R. **144.** 360.)

Sp. gr. 3.75. Easily decomp. by H_2O and dil. acids. (Moissan, Bull. Soc. 1894, (3) **11.** 1008.)

Barium carbonyl, $Ba(CO)_2$.

Sol. in H_2O. (Guntz and Mentrel, Bull. Soc. 1903, (3) **29.** 586.)

Barium *sub*chloride, BaCl.

Decomp. by H_2O. (Guntz, C. R. 1903, **136.** 751.)

Barium *sub*chloride sodium chloride, BaCl, NaCl.

Decomp. by H_2O. (Guntz, C. R. 1903, **136.** 750.)

Barium chloride, $BaCl_2$, and $+2H_2O$.

Permanent in dry air.

100 pts. H_2O at t° dissolve (*a*) pts. $BaCl_2$ and (*b*) pts. $BaCl_2+2H_2O$.

t°	*a*	*b*	t°	*a*	*b*
15.64	34.86	43.50	74.89	59.94	65.51
49.31	43.84	55.63	105.48	59.58	77.89

(Gay-Lussac, A. ch. (2) **11.** 309.)

100 pts. H_2O at t° dissolve 32.62+0.2711t pts. $BaCl_2$. (Kopp.)

100 pts. H_2O dissolve pts. $BaCl_2+2H_2O$ at t°.

t°	Pts. $BaCl_2+2H_2O$	t°	Pts. $BaCl_2+2H_2O$
16.25	39.66	62.50	48.0
20.00	42.22	75.00	63.0
22.50	43.7	87.00	65.0
37.50	51.0	100	72.0
50.00	65.0	......	....

(Brandes.)

Sol. in 2.67 pts. H_2O at 18.75°. (Abl.)

1 pt. $BaCl_2$ is sol. in 2.86 pts. H_2O at 15.5°, and 1.67 pts. at boiling temp. (M. R. and P.)

100 pts. H_2O at 15.5° dissolve 20 pts. $BaCl_2$, and 43 pts. at 87.7°. (Ure's Dict.)

Solubility in 100 pts. H_2O at t°.

t°	Pts. $BaCl_2$	t°	Pts. $BaCl_2$
0	31.1	77.5	51.9
12.2	33.9	95.65	57.7
38.4	41.2	102.5	58.9
62.75	47.7	105	59.7

(Nordenskiold, Pogg. **136.** 316.)

100 pts. H_2O dissolve pts. $BaCl_2$ at t°.

t°	Pts. $BaCl_2$	t°	Pts. $BaCl_2$
9	33.2	50	43.7
30	38.1	58	45.9
37	40.0	..	....

(Gerardin, A. ch. (4) **5.** 143.)

1 pt. $BaCl_2+2H_2O$ is sol. in 2.18 pts. H_2O at 21.5°, and the solution has sp. gr.=1.2878. (Schiff, A. **109.** 326.)

1 pt. anhydrous $BaCl_2$ is sol. in 2.86 pts. H_2O at 15°. (Gerlach.)

Solubility in 100 pts. H_2O at t°.

t°	Pts. $BaCl_2$	t°	Pts. $BaCl_2$	t°	Pts. $BaCl_2$
0	30.9	36	39.7	71	49.7
1	31.2	37	40.0	72	50.0
2	31.5	38	40.2	73	50.3
3	31.7	39	40.5	74	50.6
4	31.9	40	40.7	75	50.9
5	32.2	41	41.0	76	51.2
6	32.4	42	41.3	77	51.5
7	32.6	43	41.6	78	51.8
8	32.8	44	41.9	79	52.1
9	33.1	45	42.2	80	52.4
10	33.3	46	42.5	81	52.7
11	33.5	47	42.7	82	53.0
12	33.8	48	43.0	83	53.3
13	34.0	49	43.3	84	53.6
14	34.2	50	43.6	85	54.0
15	34.5	51	43.9	86	54.3
16	34.7	52	44.2	87	54.6
17	35.0	53	44.4	88	55.0
18	35.2	54	44.7	89	55.3
19	35.5	55	45.0	90	55.6
20	35.7	56	45.3	91	55.9
21	36.0	57	45.6	92	56.2
22	36.2	58	45.9	93	56.6
23	36.5	59	46.2	94	56.9
24	36.7	60	46.4	95	57.2
25	37.0	61	46.7	96	57.6
26	37.2	62	47.0	97	57.9
27	37.5	63	47.3	98	58.2
28	37.7	64	47.6	99	58.5
29	38.0	65	47.9	100	58.8
30	38.2	66	48.2	101	59.2
31	38.5	67	48.5	102	59.5
32	38.7	68	48.8	103	59.8
33	39.0	69	49.1	104	60.2
34	39.2	70	49.4	104.1	60.3
35	39.5	..	....	...	....

(Mulder, calculated from his own and other observations. Scheik. Verhandel. **1864.** 45.)

The saturated solution contains—

60.3 pts. $BaCl_2$ to 100 pts. H_2O, and boils at 104.1°. (Mulder.)

60.1 pts. $BaCl_2$ to 100 pts. H_2O, and boils at 104.4°. (Legrand.)

61.8 pts. $BaCl_2$ to 100 pts. H_2O, and boils at 104.5°. (Griffith.)

59.58 pts. $BaCl_2$ to 100 pts. H_2O, and boils at 105.48° (Gay-Lussac); at 106° (Kremers).

54.1 pts. $BaCl_2$ to 100 pts. H_2O, and forms crust at 104.4°; highest temperature observed, 104.9°. (Gerlach, Z. anal. **26.** 426.)

Sat. $BaCl_2$+Aq contains at:

100°	130°	144°	160°	180°	215°
36	37.3	37.5	38.9	40.7	43.1% $BaCl_2$

(Étard, A. ch. 1894, (7) **2.** 535.)

Aq. solution contains 27.6% $BaCl_2$ at 30°. (Shreinemakers, C. C. **1910,** I. 9.)

Solubility of $BaCl_2+2H_2O$ in H_2O equals 1.745 mol.-litre at 30°. (Masson, Chem. Soc. 1911, **99.** 1136.)

$BaCl_2$+Aq sat. at 8° has sp. gr. 1.27. (Anthon.)

$BaCl_2$+Aq sat. at 15° has sp. gr. 1.282. (Michel and Krafft.)

$BaCl_2$+Aq sat. at 18.1° has sp. gr. 1.285, and contains 44.31 pts. $BaCl_2+2H_2O$ to 100 pts. H_2O. (Karsten.)

Sp. gr. of $BaCl_2$+Aq at 19.5°.

% $BaCl_2$	Sp. gr.	% $BaCl_2$	Sp. gr.
8.88	1.0760	27.53	1.2245
18.24	1.1521	35.44	1.2837

(Kremers, Pogg. **99.** 444.)

Sp. gr. of $BaCl_2$+Aq at 15°.

% $BaCl_2$	Sp. gr.	% $BaCl_2$	Sp. gr.
1	1.00917	14	1.13778
2	1.01834	15	1.14846
3	1.02750	16	1.15999
4	1.03667	17	1.17152
5	1.04584	18	1.18305
6	1.05569	19	1.19458
7	1.06554	20	1.20681
8	1.07538	21	1.21892
9	1.08523	22	1.23173
10	1.09508	23	1.24455
11	1.10576	24	1.25736
12	1.11643	25	1.27017
13	1.12711	..	....

(Gerlach, Z. anal. **8.** 283.)

Sp. gr. of $BaCl_2$+Aq at 21.5°.

% $BaCl_2+2H_2O$	Sp. gr.	% $BaCl_2+2H_2O$	Sp. gr.
1	1.0073	16	1.1302
2	1.0147	17	1.1394
3	1.0222	18	1.1488
4	1.0298	19	1.1584
5	1.0374	20	1.1683
6	1.0452	21	1.1783
7	1.0530	22	1.1884
8	1.0610	23	1.1986
9	1.0692	24	1.2090
10	1.0776	25	1.2197
11	1.0861	26	1.2304
12	1.0947	27	1.2413
13	1.1034	28	1.2523
14	1.1122	29	1.2636
15	1.1211	30	1.2750

(Schiff, calculated by Gerlach, *l.c.*)

Sp. gr. of $BaCl_2$+Aq at 18°.

% $BaCl_2$	Sp. gr.	% $BaCl_2$	Sp. gr.
5	1.0445	20	1.2047
10	1.0939	24	1.2559
15	1.1473	..	......

(Kohlrausch, W. Ann. **1879.** 1.)

Sp. gr. of $BaCl_2$+Aq at 20°.

g. mols. $BaCl_2$ per l.	Sp. gr.
0.01	1.001878
0.025	1.00475
0.05	1.00929
0.075	1.01369
0.10	1.01766
0.25	1.0456
0.40	1.0726

(Jones and Pearce, Am. Ch. J. 1907, **38.** 701.)

$BaCl_2$+Aq containing 6.94% $BaCl_2$ has sp. gr. 20°/20° = 1.0640.

$BaCl_2$+Aq containing 11.38% $BaCl_2$ has sp. gr. 20°/20° = 1.1086.

(Le Blanc and Rohland, Z. phys. Ch. 1896, **19.** 279.)

Sp. gr. of $BaCl_2$+Aq at 25°.

$BaCl_2$+Aq	Sp. gr.
1-normal	1.0884
½- "	1.0441
¼- "	1.0226
1/8- "	1.0114

(Wagner, Z. phys. Ch. 1890, **5.** 35.)

Sp. gr. of $BaCl_2$+Aq.

t°	Concentration of $BaCl_2$+Aq	Sp. gr.
25°	1 pt. $BaCl_2$ in 3.684 pts. H_2O	1.2194
22.8	1 " " " 52.597 " "	1.0145

(Hittorf, Z. phys. Ch. 1902, **39.** 628.)

Temp. of Maximum Density.

Weight of $BaCl_2$ in 1000 grams H_2O	Temp. of maximum density	Molecular reduction of temp. of M. D.
0	3.982°	
6.73	3.207°	23.94
10.42	2.783°	23.88
20.83	1.572°	24.04
41.72	—0.843°	24.04

(De Coppet, C. R. 1897, **125.** 533.)

$BaCl_2$+Aq containing 10% $BaCl_2$ boils at 100.6°. (Gerlach.)

$BaCl_2$+Aq containing 20% $BaCl_2$ boils at 101.9°. (Gerlach.)

B.-pt. of $BaCl_2$+Aq containing pts. $BaCl_2$ to 100 pts. H_2O. G = according to Gerlach (Z. anal. **26.** 443); L = according to Legrand (A. ch. (2) **59.** 452).

B.-pt.	G	L
100.5°	6.4	11.0
101.0	12.7	19.6
101.5	19.0	26.2
102.0	25.3	32.5
102.5	31.6	38.6
103.0	37.7	44.5
103.5	43.7	50.3
104.0	49.5	56.0
104.4	....	60.1
104.5	55.2	....

Less sol. in H_2O containing HCl than in pure H_2O, and scarcely sol. in conc. HCl+Aq. (Berzelius.)

Solubility of $BaCl_2$ in HCl+Aq at 0°. $BaCl_2$=no. ½ mols. (in milligrammes) dissolved in 10 cc. of the liquid; HCl=no. mols. (in milligrammes) contained in the same quantity of liquid.

$BaCl_2$	HCl	Sum of mols.	Sp. gr.
29.45	0	29.45	1.250
27.8	1.1	28.9	1.242
26.075	2.8	28.875	1.228
23.4	5.0	28.4	1.210
14.0	14.36	28.36	1.143
10.2	18.775	28.975	1.118
6.67	22.75	29.42	1.099
2.74	32.0	34.74	1.079
0.29	50.5	50.79	1.088

(Engel, Bull. Soc. (2) **45.** 653.)

Sol. in about 8000 pts. conc. HCl+Aq.

Sol. in about 20,000 pts. conc. HCl+Aq through which HCl gas was passed.

Practically insol. in conc. HCl+Aq containing $^1/_6$ vol. ether. (Mar, Sill. Am. J. **143.**

Solubility in HCl+Aq at 30°.

Composition of the solution		Solid phase
% by wt. HCl	% by wt. $BaCl_2$	
0	27.6	$BaCl_2, 2H_2O$
5.94	12.97	"
11.55	3.85	"
18.11	0.46	"
32.35	0.00	"
37.34	0.00	$BaCl_2, 2H_2O+BaCl_2, H_2O$
38.63	0.00	$BaCl_2, H_2O$

(Schreinemakers, Z. phys. Ch. 1909, **68.** 89.)

Much less sol. in HNO_3+Aq than in H_2O, because $Ba(NO_3)_2$ is nearly insol. therein. (Wurtz.)

$BaCl_2$ is sol. in about—

4.00 pts. H_2O.

5.00 pts. NH_4OH+Aq (conc.).

5.33 pts. NH_4OH+Aq (1 vol. conc.: 3 vols. H_2O).

5.33 pts. HCl+Aq (1 vol. conc.: 4 vols. H_2O).

8.00 pts. $HC_2H_3O_2$+Aq (1 vol. commercial acid: 1 vol. H_2O).

6.00 pts. NH_4Cl+Aq (1 pt. NH_4Cl : 10 pts. H_2O).

6.00 pts. $NH_4C_2H_3O_2$+Aq (dil. NH_4OH+Aq neutralized by dil. $HC_2H_3O_2$+Aq.)

6.67 pts. $NaC_2H_3O_2$+Aq (commercial $HC_2H_3O_2$ neutralized by Na_2CO_3, and dil. with 4 vols. H_2O).

6.33 pts. $Cu(C_2H_3O_2)_2$+Aq. *See* Stolba (Z. anal. **2.** 390).

5.67 pts. grape sugar (1 pt. grape sugar: 10 pts. H_2O). (Pearson, Zeit. Chem. **1869.** 662.)

$BaCl_2+NH_4Cl$. Solubility of $BaCl_2$ in NH_4Cl+Aq at 30°.

Composition of the solution		Solid phase
% NH_4Cl	% $BaCl_2$	
0	27.6	$BaCl_2.2H_2O$
5.71	22.16	"
10.06	18.36	"
13.84	15.42	"
20.00	10.89	"
24.69	8.33	"
25.79	7.95	$BaCl_2.2H_2O+NH_4Cl$
26.06	7.99	"
27.47	3.56	NH_4Cl
29.5	0	"

(Schreinemakers, Z. phys. Ch. 1909, **66.** 688.)

See also under **Ammonium chloride.**

$BaCl_2+Ba(OH)_2$. Solubility of $BaCl_2$ in BaO+Aq at 30°.

Composition of the solution		Solid phase
% by wt. BaO	% by wt. $BaCl_2$	
0	27.6	$BaCl_2, 2H_2O$
1.78	27.42	"
1.79	27.31	$BaCl_2, 2H_2O+BaCl(OH), 2H_2O$
1.75	27.41	"
2.33	24.98	$BaCl(OH), 2H_2O$
2.50	24.20	"
3.27	21.46	"
4.67	19.18	"
4.86	18.97	$BaCl(OH), 2H_2O+BaO, 9H_2O$
4.29	18.83	"
4.64	18.77	"
4.65	18.10	"
4.62	18.04	$BaO, 9H_2O$
4.60	17.08	"
4.58	12.81	"
4.45	10.77	"
4.99	0	"

(Schreinemakers, Z. phys. Ch. 1909, **68.** 88.)

Sol. in $CuCl_2,NH_4Cl$+Aq at 30°. (Schreinemakers, Z. phys. Ch. 1909, **66.** 688.)

The solubility data for the system $BaCl_2$+$CuCl_2$+KCl+Aq have been determined at 40° and 60°. (Schreinemakers, C. C. **1915,** I. 933.)

$BaCl_2+HgCl_2$. Solubility of $BaCl_2$+$HgCl_2$ in H_2O.

t°	Gms. per 100 g. solution		Solid phase
	$BaCl_2$	$HgCl_2$	
10.4°	23.58	50.54	$BaCl_2,2H_2O+HgCl_2$
10.4	23.44	50.74	$BaCl_2,3HgCl_2, 6H_2O$
10.4	22.58	51.23	$BaCl_2,3HgCl_2, 6H_2O$
10.4	22.48	51.41	$BaCl_2,3HgCl_2, 6H_2O$
10.4	22.10	51.66	$BaCl_2,3HgCl_2, 6H_2O$
10.4	21.64	51.74	$BaCl_2,2H_2O+HgCl_2$
25.0	23.02	54.83	$BaCl_2,2H_2O+HgCl_2$

(Foote and Bristol, Am. Ch. J. **32.** 248.)

Solubility of $BaCl_2+HgCl_2$ in H_2O.

Temp. = 30			Temp. = 0°		
% $HgCl_2$	% $BaCl_2$	Solid phase	% $HgCl_2$	% $BaCl_2$	Solid phase
0	27.77	$BaCl_2.2H_2O$	0	23.70	$BaCl_2.2H_2O$
2.90	27.56	"	14.25	24.0	"
7.09	27.47	"	36.20	24.89	"
12.98	26.99	"	46.12	24.07	$BaCl_2, 3HgCl_2.6H_2O+$
22.61	26.89	"	46.05	24.03	" $BaCl_2.2H_2O$
34.57	26.69	"	46.07	24.05	"
46.50	25.22	"	46.59	23.28	$BaCl_2, 3HgCl_2.6H_2O$
55.16	23.46	$HgCl_2+BaCl_2.2H_2O$	47.78	21.05	"
55.32	23.08	"	48.43	20.64	$BaCl_2, 3HgCl_2.6H_2O+HgCl_2$
55.19	22.98	"	48.49	20.71	"
48.97	17.87	$HgCl_2$	44.33	18.50	$HgCl_2$
41.30	14.26	"	29.0	11.59	"
27.62	8.41	"	16.36	6.11	"
14.19	2.65	"	3.95	0	"
7.67	0	"			
			Temp. = 40°		
			56.57	22.98	$BaCl_2.2H_2O+HgCl_2$

(Schreinemakers, Ch. Weekbl. 1911, **7.** 202.)

$BaCl_2+KCl$. Sol. in sat. KCl+Aq, at first without pptn. The KCl is pptd. after a time until a state of equilibrium is reached.

100 pts. H_2O at 16.6° dissolve 33.8–27.2 pts. KCl and 18.2–34.9 pts. $BaCl_2$. (Kopp, A. **34.** 267.)

100 g. sat. solution of $BaCl_2$+KCl contain 13.83 g. $BaCl_2$ and 18.97 g. KCl at 25°. (Foote, Am. Ch. J. **32.** 253.)

$BaCl_2+Ba(NO_3)_2$. $BaCl_2$ is sol. in sat. $Ba(NO_3)_2$+Aq.

Solubility of $BaCl_2+Ba(NO_3)_2$ in H_2O. Both salts present in solid phase.

t°	Gms. per 100 gms. solution		t°	Gms. per 100 gms. solution	
	$BaCl_2$	$Ba(NO_3)_2$		$BaCl_2$	$Ba(NO_3)_2$
0	22.5	4.3	100	31	14
20	24.5	6.0	140	32	20
40	26.5	7.5	180	33	26
60	28.5	9.5	210	32	32

(Etard, A. Ch. (7) **2.** 535.)

Very slowly sol. in sat. $NaNO_3$+Aq with separation of $Ba(NO_3)_2$.

Rapidly sol. in sat. KNO_3+Aq, forming $Ba(NO_3)_2$, which separates out. (Karsten.)

$BaCl_2$+NaCl. $BaCl_2$ is sol. in NaCl+Aq at first without separation of NaCl, which, however, finally separates.

100 pts. H_2O dissolve, when both salts are in excess—

	1	2	3	4	5	6
NaCl . . .	35.9	4.1	....	40.4	35.3	....
$BaCl_2$ . . .	....	34.5	35.0	....	19.4	60.3
		38.6			54.7	

1, 2, and 3 are at 17°. (Kopp, A. **34.** 268.)
4, 5, and 6 are at b.-pt. (Mulder.)

Solubility of $BaCl_2$+NaCl.

100 pts. H_2O dissolve pts. $BaCl_2$ and NaCl at t°.

t°	Pts. $BaCl_2$	Pts. NaCl	t°	Pts. $BaCl_2$	Pts. NaCl
10	4.1	33.9	60	9.7	33.5
20	4.1	33.8	70	11.7	33.6
30	5.0	33.7	80	13.9	33.6
40	6.3	33.6	90	15.9	33.6
50	7.9	33.5	100	17.9	33.6

(Precht and Wittgen, B. **14.** 1667.)

Solubility of $BaCl_2$+NaCl in HCl+Aq at 30°.

Solid phase, NaCl			Solid phase, $BaCl_2+2H_2O$		
Sp. gr. of sat. solution	G. mol. litre HCl	G. mol. litre NaCl	Sp. gr. of sat. solution	G. mol.-litre HCl	G. mol.-litre $BaCl_2$
1.2018	0.0000	5.400	1.3056	0.0000	1.745
1.1906	0.4575	4.932	1.2651	0.4709	1.468
1.1801	0.969	4.386	1.2147	1.107	1.122
1.1633	1.786	3.589	1.1789	1.622	0.861
1.1512	2.412	2.978	1.1419	2.234	0.592
1.1427	3.052	2.463	1.1068	3.041	0.307
1.1289	4.152	1.628	1.0880	3.953	0.124
1.1188	5.950	0.630	1.0895	3.059	0.020
1.1258	7.205	0.268	1.1024	6.234	0.00
			1.1609	10.25	0.00

(Masson, Chem. Soc. 1911, **99.** 1136.)

Solubility of $BaCl_2$+NaCl in HCl+Aq at 30°.

%HCl	%NaCl	%$BaCl_2$	Solid phase
0	23.85	3.8	NaCl, $BaCl_2.2H_2O$
4.84	18.07	2.27	"
12.02	9.55	0.82	"
17.20	4.65	0.29	"
23.16	1.54	0.00	"
28.66	0.47	0.00	"
36.51	0.12	0.00	NaCl+$BaCl_2.H_2O$

(Schreinemakers, Arch. Néer. Sc. ex. nat. (2) **15.** 91.)

Insol in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 827.)

Solubility in alcohol: 100 pts. alcohol of given sp. gr. dissolve pts. of the anhydrous, and crystallized salt.

Sp. gr.	Pts. $BaCl_2$	Pts. $BaCl_2+2H_2O$
0.900	1.00	1.56
0.848	0.29	0.43
0.834	0.185	0.32
0.817	0.09	0.06

(Kirwan.)

Insol. in abs. alcohol, or below 19° in alcohol of over 91%. Dil. alcohol dissolves less $BaCl_2$ than corresponds to the amount of H_2O present. (Gerardin, A. ch. (4) **5.** 142.)

Solubility in 100 pts. alcohol at t°. D = sp. gr. of alcohol; S = solubility.

D=0.9904		D=0.9848		D=0.9793		D=0.9726	
t°	S	t°	S	t°	S	t°	S
14	29.1	14	25.0	11	19.6	15	15.6
25	32.0	32	29.1	15	20.4	23	17.0
32	33.5	39	30.9	20	21.7	33	19.1
47	37.4	50	33.2	35	24.6	50	22.0
60	39.8	63	37.6	45	26.8	..	....

D=0.9573		D=0.9390		D=0.8967		D=0.8429	
t°	S	t°	S	t°	S	t°	S
13	10	12	6.5	12	0.1	12	0.00
24	11.4	23	7.2	30	4.3	19	0.00
34	12.9	31	8.3	47	4.9	25	0.04
39	13.8	37	9.0	..	...	50	0.28
50	15.2	47	10.1	..	...	67	0.377

(Gerardin, A. ch. (4) **5.** 142.)

Solubility in dil. alcohol of x% by weight at 15°.

% alcohol	0	10	20	30	40	60	80
Pts. $BaCl_2, 2H_2O$	30.25	23.7	18.0	12.8	9.3	3.4	0.5

(Schiff, A. **118.** 365.)

Sol. in 6885–8108 pts. 99.3% alcohol at 14.5°, and in 1857 pts. at ebullition. (Fresenius.)

Solubility of $BaCl_2$ in alcohol+Aq.

t°	% alcohol	% $BaCl_2$	Solid phase
30°	0	27.95	$BaCl_2.2H_2O$
"	32.67	10.63	"
"	50.16	5.68	"
"	66.72	2.23	"
"	92.53	0.05	"
"	94.83	0.07	$BaCl_2.2H_2O+BaCl_2.H_2O$
"	94.75	0.05	"
"	94.60	0.07	"
"	97.14	.....	$BaCl_2.H_2O$
"	98.17	0.08	$BaCl_2.H_2O+BaCl_2$
"	99.41	.....	$BaCl_2$
60°	0	31.57	$BaCl_2.2H_2O$
"	16.68	20.16	"
"	34.10	13.21	"
"	66.02	2.82	"
"	88.55	0.25	"
"	90.11	0.09	$BaCl_2.2H_2O+BaCl_2.H_2O$
"	90.39	.....	"
"	93.95	.....	$BaCl_2.H_2O$

(Schreinemakers and Massink, Chem. Weekbl. 1910, **7.** 213.)

100 pts. absolute methyl alcohol dissolve 2.18 pts. $BaCl_2$ at 15.5°, and 7.3 pts. $BaCl_2$, $2H_2O$ at 6°. (de Bruyn, Z. phys. Ch. **10.** 783.)

At 15° C. 1 pt. by weight is sol. in:—

78 pts. methyl alcohol of sp. gr. 0.790
7,000 " ethyl " " " " 0.8035
100,000 " propyl " " " " 0.8085

(Rohland, Z. anorg. 1897, **15.** 413.)

Absolutely insol. in boiling amyl alcohol. (Browning, Sill. Am. J. **144.** 459.)

Absolutely insol. in acetic ether. (Cann, C. R. **102.** 363.)

Very sl. sol. in acetone. (Krug and M'Elroy, J. Anal. Ch. **6.** 184.)

100 pts. by weight of glycerine dissolve 10 pts. $BaCl_2$ at 15.5°. (de Bruyn, Z. phys. Ch. **10.** 783.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329.) (Eidmann, C. C. **1899,** II. 1014.)

Insol. in benzonitrile. (Naumann, B. 1914, **47.** 1370.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Insol. in anhydrous pyridine, 97% pyridine+Aq. and 95% pyridine+Aq. Sl. sol. in 93% pyridine+Aq. (Kahlenberg, J. Am. Chem. Soc. 1908, **30.** 1107.)

+H_2O. Solution of monohydrate sat. at 6° contains 31.57% $BaCl_2$. (Schreinemakers, Chem. Weekbl. 1910, **7.** 213.)

2.5 grams of the monohydrate are sol. in 100 cc. of methyl alcohol at 14°. (Kirschner, Z. phys. Ch. 1911, **76.** 176.)

Exact solubility in methyl alcohol cannot be determined as $BaCl_2+H_2O$ separates out from a sat. solution of the dihydrate. (Kirschner, Z. phys. ch. 1911, **76.** 177.)

Barium cadmium chloride, $BaCl_2,CdCl_2+4H_2O$.

Easily sol. in H_2O. (v. Hauer.)

Solubility in H_2O at t°.

t°	100 pts. solution contain pts.			100 g. of solution contain g. salt	100 g. H_2O dissolve g. salt	100 mols. H_2O dissolve mols. of anhydrous salt
	Cl	Ba	Cd			
22.5	15.19	14.71	11.98	41.88	72.06	3.32
32.9	16.18	16.09	12.40	44.59	80.73	3.72
41.4	16.95	16.81	13.05	46.87	88.01	4.06
53.4	18.21	18.13	13.95	50.30	101.21	4.66
62.0	18.81	18.74	14.73	52.28	109.56	5.05
97.8	22.48	22.00	17.57	62.05	163.50	7.53
108.3	23.51	22.79	18.53	64.83	184.33	8.49
109.2	23.69	29.95	18.67	65.31	188.27	8.67

(Rimbach, B. 1897, **30.** 3083.)

$BaCl_2.2CdCl_2+5H_2O$. Quite difficultly sol. in H_2O. (v. Hauer.)

Solubility in H_2O at t°.

t°	100 pts. by wt. of solution contain pts. by wt.			100 g. of solution contain g. salt	100 g. H_2O dissolve g. salt	100 mols. H_2O dissolve mols. of anhydrous salt
	Cl	Ba	Cd			
22.6	16.89	11.00	17.71	45.60	83.82	2.63
41.3	18.15	11.77	19.22	49.14	96.62	3.03
53.9	18.78	12.41	19.85	51.04	104.25	3.27
62.2	19.66	12.83	20.59	53.08	113.13	3.55
69.5	20.18	13.09	21.20	54.47	119.64	3.76
107.2	23.31	14.87	24.11	62.29	165.18	5.19
107.2	23.16	14.93	24.39	62.48	166.53	5.23

(Rimbach, B. 1897, **30.** 3083.)

Barium mercuric chloride, basic, $BaCl_2, HgO+6H_2O$.

Decomp. by H_2O. (André, C. R. **104.** 431.)

Barium mercuric chloride, $BaCl_2, 2HgCl_2+2H_2O$.

Efflorescent in dry air; sol. in H_2O. (v. Bonsdorff, Pogg. **17.** 130.)

The salt $BaCl_2, 2HgCl_2+2H_2O$ described by Bonsdorff does not form under the conditions which he gives. (Foote, Am. Ch. J. 1904, **32.** 251.)

$BaCl_2,3HgCl_2+6H_2O$. Solubility determinations with mixtures of $BaCl_2$ and $HgCl_2$ show that these chlorides do not form a double salt at 25°, but that a transition temp. exists at about 17.2° below which the salt $BaCl_2, 3HgCl_2+6H_2O$ forms. (Foote, Am. Ch. J. 1904, **32.** 251.)

$+8H_2O$. Less sol. in H_2O than the Sr and Mg double salts. (Swan, Am. Ch. J. 1898, **20.** 633.)

Barium rhodium chloride, $3BaCl_2, Rh_2Cl_6$.

See **Chlororhodite, barium.**

Barium stannous chloride, $BaCl_2, SnCl_2+4H_2O$.

Sol. in H_2O. (Poggiale, C. R. **20.** 1183.)

Barium stannic chloride.

See **Chlorostannate, barium.**

Barium uranium chloride, $BaCl_2,UCl_4$.

Decomp. by H_2O. (Aloy, Bull. Soc. 1899, (3) **21.** 265.)

Barium zinc chloride, $BaCl_2, ZnCl_2+4H_2O$.

Deliquescent, and sol. in H_2O. (Warner, C. N. **27.** 271.)

Pptd. from warm solution only. (Ephraim, Z. anorg. 1910, **67.** 381.)

$+2\frac{1}{2}H_2O$. Pptd. from cold solution. (Ephraim.)

Barium chloride hydrazine, $BaCl_2, 2N_2H_4$.

Hydroscopic. (Franzen, Z. anorg. 1908, **60.** 290.)

Barium chloride hydroxylamine, $BaCl_2, 2NH_2OH$.

Very sol. in H_2O. (Crismer, Bull. Soc. (3) **3.** 118.)

Barium chloride sulphuric anhydride, $BaCl_2, 2SO_3$.

Decomp. by H_2O. (Schultz-Sellack, B. **4.** 113.)

Barium chlorofluoride, $BaClF$.

Difficultly sol. in H_2O, but much more sol. than BaF_2. Decomp. by H_2O, so that when washed on filter, the filtrate contains more $BaCl_2$ than BaF_2. (Berzelius, Pogg. **1.** 19.)

Insol. in and undecomp. by boiling alcohol; sol. in conc. HCl and HNO_3. Decomp. by hot H_2O, hot H_2SO_4, dil. acetic acid, dil. HCl or dil. HNO_3. (Defacqz, C. R. 1904, **138.** 198.)

Barium cyanamide, $BaCN_2$.

Decomp. by H_2O. (Frank, C. C. **1902,** II. 774.)

Barium *sub*fluoride sodium fluoride, BaF, NaF.

Decomp. by H_2O. (Guntz, C. R. 1903, **136.** 750.)

Barium fluoride, BaF_2.

Scarcely sol. in H_2O (Berzelius); less sol. in H_2O than CaF_2..

1 liter H_2O dissolves 1630 mg. BaF_2 at 18°. (Kohlrausch, Z. phys. Ch. 1904, **50.** 356.)

1605 mg. are contained in 1 l. of sat. solution at 18°. (Kohlrausch, Z. phys. Ch. 1908, **64.** 168.)

Insol. in molten $MnCl_2$, $MnBr_2$, MnI_2, $MnCl_2+BaCl_2$, $MnBr_2+BaBr_2$ and MnI_2+BaI_2. (Defacqz, A. ch. 1904, (8) **1.** 350.)

Easily sol. in HCl, HNO_3, or HF+Aq. (Gay-Lussac and Thénard.)

Sl. sol. in liquid HF. (Franklin, Z. anorg. 1905, **46.** 2.)

Insol. in ethyl acetate. (Naumann, B. 1910, **43.** 314.)

Sol. in an aqueous solution of sodium citrate. (Spiller.)

Barium tin (stannic) fluoride.

See **Fluostannate, barium.**

Barium tellurium fluoride, BaF_2, $2TeF_4$.

Decomp. by H_2O. (Högbom, Bull. Soc. (2) **35.** 60.)

Barium titanium fluoride.

See **Fluotitanate, barium.**

Barium titanyl fluoride, TiO_2F_2, BaF_2.

See **Fluoxypertitanate** *and* **fluoxytitanate, barium.**

Barium uranyl fluoride.

See **Fluoxyuranate, barium.**

Barium vanadyl fluoride.

See **Fluoxyvanadate, barium.**

Barium zirconium fluoride, $3BaF_2$, $2ZrF_4+2H_2O$.

Insoluble precipitate. (Marignac.)

See also **Fluozirconate, barium.**

Barium fluoiodide, BaF_2, BaI_2.

Decomp. by H_2O, dil. HCl, dil. HNO_3 or hot H_2SO_4. Sol. in HI and HNO_3. Insol. in and undecomp. by boiling alcohol. Decomp. by dil. acetic acid. (Defacqz, C. R. 1904, **138.** 199.)

Barium hydride, BaH.

Decomp. by H_2O or HCl+Aq. (Winkler, B. **24.** 1979.)

Decomp. by H_2O. (Guntz, C. R. 1901, **132.** 964.)

Barium hydrosulphide, BaS_2H_2.

Easily sol. in H_2O. Insol. in alcohol.

$+4H_2O$. Sol. in H_2O, and the solution dissolves S. (Veley, Chem. Soc. **49.** 369.)

Barium hydroxide, BaO_2H_2.

100 pts. cold H_2O dissolve 5 pts. BaO_2H_2.
" boiling " 50 "
(Davy.)

100 pts. H_2O at 20° dissolve 3.45 pts. BaO.
(Bineau, C. R. **41.** 509.)

100 pts. H_2O at 13° dissolve 2.86 pts. BaO.
" " 47° " 13.3 "
" " 70° " 17.9 "
(Osann.)

100 pts. H_2O dissolve pts. BaO at t°.

t°	Pts. BaO	t°	Pts. BaO	t°	Pts. BaO
0	1.5	30	5.0	60	18.76
5	1.75	35	6.17	65	24.67
10	2.22	40	7.36	70	31.9
15	2.89	45	9.12	75	56.85
20	3.48	50	11.75	80	90.77
25	4.19	55	14.71	..	.....

(Rosenthiel and Rühlmann, J. B. **1870.** 314.)

100 pts. H_2O dissolve at 25° 55.08 millimols. $\frac{BaO_2H_2}{2}$. (Herz and Knoch, Z. anorg. 1904, **41.** 315.)

Sp. gr. of BaO_2H_2+Aq.

%BaO	Sp. gr.	%BaO	Sp. gr.
30	1.6	1.8	1.02
19	1.3	0.9	1.01
2.6	1.03	...	....

(Dalton.)

Sp. gr. of BaO_2H_2+Aq at 18° containing 1.25% BaO_2H_2=1.0120; containing 2.5%=1.0253. (Kohlrausch, W. Ann. 1879, **6.** 41.)

Sp. gr. of BaO_2H_2+Aq at 80°.

Sp. gr.	% BaO_2H_2 by volume	% BaO_2H_2 by weight	Sp. gr.	% BaO_2H_2 by volume	% BaO_2H_2 by weight
1.514	58.22	38.45	1.219	24.53	20.12
1.500	56.31	37.54	1.200	23.00	19.17
1.479	54.14	36.60	1.195	22.15	18.53
1.458	49.38	33.87	1.174	19.83	16.89
1.450	48.90	33.72	1.152	17.78	15.43
1.413	45.99	32.55	1.129	16.01	14.18
1.400	45.00	32.14	1.125	15.80	14.04
1.390	44.22	31.81	1.114	14.56	13.07
1.375	42.40	30.84	1.100	13.06	11.87
1.368	41.45	30.30	1.076	10.58	9.83
1.350	38.60	28.59	1.062	9.16	8.62
1.338	37.30	27.88	1.049	7.55	7.20
1.312	35.02	26.69	1.040	6.51	6.26
1.301	34.02	26.13	1.031	5.18	5.02
1.278	31.48	24.67	1.022	4.78	4.67
1.249	28.14	22.52	1.015	3.90	3.84
1.236	26.41	21.36	1.009	3.37	3.34

(Haff, C. N. 1902, **86.** 284.)

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 827.)

More sol. in NaCl+Aq, KNO_3+Aq, or $NaNO_3$+Aq than in H_2O. (Karsten.)

Not precipitated by alcohol.

Sol. with combination in absolute alcohol and anhydrous methyl alcohol. Insol. in ether.

Insol. in acetone. (Naumann, B. 1904, **37.** 4329; Eidmann, C. C. **1899,** II. 1014.)

Solubility in acetone+Aq at 25°.

A=cc. acetone in 100 cc. acetone+Aq.

$\frac{BaO_2H_2}{2}$=millimols. BaO_2H_2 in 100 cc. of the solution.

S=sp. gr. of the solution.

A	$\frac{BaO_2H_2}{2}$	S
0	55.08	1.04790
10	31.84	1.01677
20	17.79	0.99268
30	9.10	0.97630
40	4.75	0.95605
50	1.54	0.93980
60	0.48	0.91790
70	0.08	0.89562

(Herz, Z. anorg. 1904, **41.** 321.)

BaO_2H_2 is sol. in an aqueous solution of cane sugar (Hunton, Phil. Mag. (3) **11.** 156); also in an aqueous sol. of mannite (Favre, A. ch. (3) **11.** 76); sorbine (Pelouze); hot solution of quercite, separating on cooling (Dessaignes).

$+3H_2O$. Decomp. by H_2O free from carbonic acid. Sl. sol. in alcohol and ether. (Bauer, Z. anorg. 1905, **47**, 416.)

Solubility in H_2O the same as that of the comp. with $8H_2O$. Insol. in alcohol and ether. (Bauer, Zeit. angew. Ch. 1903, **17.** 341.)

Nearly insol. in alcohol and ether. (Bauer, Zeit. angew. Ch. 1903, **16.** 349.)

$+8H_2O$. Sol. in 20 pts. cold, and 3 pts. boiling H_2O (Graham); 17.5 pts. H_2O at 15.5°, and in all proportions of hot H_2O. (Hope.) Sol. in 19 pts. H_2O at 15°, and 2 pts. at 100°. (Wittstein.)

If $BaO_2H_2+8H_2O$ is heated it dissolves in the crystal H_2O and the solution has the following bpts.

%BaO	49.05	50.05	52.43	53.72
B.-pt.	103°	104°	105°	106°
%BaO	55.35	57.49	58.74	61.44
B.-pt.	107°	108°	108.5°	109°

$BaO_2H_2+3H_2O$ separates at 109°. (Bauer, Zeit. angew. Ch. 1903, **17.** 345.)

B.-pt. of $BaO_2H_2.8H_2O$+Aq at 732 mm.

Bpt.	Time	%BaO
78° (mpt.)	0	48.45
78	4′	48.45
103	6′ 30″	49.05
104	6′ 45″	50.05
105	7′ 30″	52.43
106	9′ 25″	53.72
107	10′ 45″	55.35
108	12′	57.49
108.5	—	58.74
109	13′	61.44
109	17′ 40″	63.65
108	17′ 50″	66.53
105	18′	67.51
100	18′ 45″	68.17

(Bauer, Z. anorg. 1905, **47.** 407.)

Solubility in $Ba(NO_3)_2$+Aq at 25°.

Solution sat. with respect to both $Ba(NO_3)_2$ and BaO_2H_2, $8H_2O$.

Sp. gr. 25°/25°	g. BaO as $Ba(OH)_2$ in 100 g. H_2O	g. Ba $(NO_3)_2$ in 100 g. H_2O
1.1448	5.02	11.48
1.1371	4.93	10.21
1.1288	4.83	8.66
1.1220	4.72	7.55
1.1133	4.72	7.01
1.1062	4.65	6.82
1.1044	4.61	6.55
1.1010	4.64	6.08
1.0975	4.60	5.66
1.0949	4.55	5.46
1.0937	4.54	5.32
1.0885	4.52	4.44
1.0864	4.53	4.41
1.0840	4.52	4.04
1.0790	4.48	3.47
1.0774	4.46	3.14
1.0731	4.40	2.79
1.0711	4.42	2.53
1.0651	4.35	1.88
1.0626	....	....
1.0640	4.35	1.45
1.0538	4.29	0.43
1.0512	4.29	0

(Parsons and Corson, J. Am. Chem. Soc. 1910, **32.** 1385.)

Solubility of $Ba(OH)_2+8H_2O$ (solid phase) in MCl+Aq (mol. per litre of solution) at 25°.

Solution of	(Cl′)	(OH′)
LiCl	0	0.555
"	0.75	0.745
"	1.42	0.937
"	2.30	1.336
KCl	0.86	0.645
"	1.75	0.660
"	3.40	0.676
NaCl	0	0.555
"	0.73	0.630
"	1.43	0.699
"	2.82	0.806
RbCl	1.25	0.648

(Herz, Z. anorg. 1910, **67.** 366.)

Solubility of BaO in NaOH+Aq at 30°.

% Na_2O	%BaO	Solid phase
0	4.99	$BaO.9H_2O$
4.78	1.29	"
6.43	0.89	"
9.63	0.57	"
11.62	0.53	"
17.87	0.47	"
23.28	1.06	"
24.63	1.87	$BaO.9H_2O+BaO.4H_2O$
26.14	1.84	$BaO.4H_2O$
27.72	1.75	"
28.43	1.58	"
29.24	1.34	$BaO.4H_2O+BaO.2H_2O$
32.12	0.82	$BaO.2H_2O$
34.72	0.59	"
41.09	0.57	$BaO.2H_2O+NaOH.H_2O$
42	0	$NaOH.H_2O$

(Schreinemakers, Z. phys. Ch. 1909, **68.** 84.)

50% alcohol dissolves less than 0.5% of its wt. of $BaO_2H_2+8H_2O$. (Beckmann, J. pr. 1883, (2) **27.** 138.)

Barium *sub*iodide sodium iodide, BaI, NaI.

Decomp. by H_2O. (Guntz, C. R. 1903, **136.** 750.)

Barium iodide, BaI_2.

Not deliquescent. Very sol. in H_2O and alcohol. 100 pts. of anhydrous salt dissolve:

at	0°	19.5°	30°	40°	60°	90°	106°
in	59	48	44	43	41	37	35 pts. H_2O.

(Kremers, Pogg. **103.** 66.)

Sp. gr. of BaI_2+Aq containing:

5	10	15	20	25	30% BaI_2
1.045	1.091	1.143	1.201	1.265	1.333
35	40	45	50	55	60% BaI_2.
1.412	1.495	1.596	1.704	1.825	1.970

(Kremers, Pogg. **111.** 63, calculated by Gerlach, Z. anal. **8.** 279.)

Easily sol. in alcohol. (Henry.)
Sl. sol. in benzonitrile. (Naumann, B. 1914, **47.** 1369.)
Sol. in acetone. (Naumann, B. 1904, **37.** 4328; Eidmann, C. C. **1899,** II. 1014.)
Sol. in methyl acetate. (Naumann, B. 1909, **42.** 3789.)
$+2H_2O$. At 15° C., 1 pt. by weight in sol. in:

22 pts. methyl alcohol sp. gr. 0.790
93 " " " " " 0.8035
307 " " " " " 0.8085

(Rohland, Z. anorg. 1897, **15.** 413.)

$+7H_2O$. (Thomson, B. **10.** 1343.)

The composition of the hydrates formed by BaI_2 at different dilutions is calculated from determinations of the lowering of the fr.-pt. produced by BaI_2 and of the conductivity and sp. gr. of BaI_2+Aq. (Jones, Am. Ch. J. 1905, **34.** 306.)

Barium iodide, basic, $Ba(OH)I+9H_2O$.
See **Barium oxyiodide.**

Barium bismuth iodide, BaI_2, $2BiI_3+18H_2O$.
Deliquescent; decomp. by H_2O. (Linau, Pogg. **111.** 240.)

Barium cadmium iodide, BaI_2, CdI_2+5H_2O.
Deliquescent. (Croft.)

Barium mercuric iodide, BaI_2, $2HgI_2$.
Decomp. by much H_2O. (Boullay.)
BaI_2, HgI_2. Sol. in H_2O. (Boullay.)
Sp. gr. of sat. solution = 3.575–3.588. (Rohrbach, W. Ann. **20.** 169.)
$+5H_2O$. (Duboin, C. R. 1906, **143.** 314.)
$2BaI_2$, $3HgI_2+16H_2O$. (Duboin, C. R. 1906, **142.** 888.)
BaI_2, $5HgI_2+8H_2O$. As the corresponding Ca salt. (Duboin, C. R. 1906, **142.** 888.)
$3BaI_2$, $5HgI_2+21H_2O$. Very deliquescent. (Duboin, C. R. 1906, **142.** 889.)

Barium stannous iodide.
Very sol. in H_2O. (Boullay.)

Barium zinc iodide, BaI_2, $2ZnI_2$.
Deliquescent, and sol. in H_2O. (Rammelsberg.)
$+4H_2O$. Very hydroscopic. (Ephraim, Z. anorg. 1910, **67.** 385.)

Barium nitride, Ba_3N_2.
Decomp. H_2O violently, not alcohol. (Maquenne, A. ch. (6) **29.** 219.)
BaN_6.
See **Barium azoimide.**

Barium oxide, BaO.
Sol. in H_2O with evolution of heat.
Easily sol. in dil. HNO_3, or HCl+Aq.
Solubility in NaOH+Aq. *See* **Barium hydroxide.**
Solubility in Na_2O, HCl, $+H_2O$ at 30°. (Schreinemakers, Z. phys. Ch. 1909, **68.** 98.)
Solubility in Na_2O, NaCl, $BaCl_2$+Aq at 30°. (Schreinemakers.)
Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 827.)
Sol. with combination in absolute alcohol and anhydrous wood-spirit. Insol. in ether.
Easily sol. in absolute methyl alcohol.
1 l. absolute ethyl alcohol sat. with BaO at 9° contains 213.8 g. BaO. (Berthelot, Bull. Soc. **8.** 389.)
Sol. in methyl alcohol. (Neuberg and Neimann, Biochem. Z. 1906, **1.** 173.)
Insol. in acetone. (Eidmann, C. C. **1899,** II. 1014; Naumann, B. 1904, **37.** 4329.)
Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)
See also **Barium hydroxide.**

Barium *per*oxide, BaO_2.
Insol. in H_2O; decomp. by boiling H_2O.

Sol. in acids with formation of hydrogen dioxide.

Forms hydrate with $8H_2O$; also $10H_2O$ (Berthelot, A. ch. (5) **21.** 157); also a compound BaO_2, H_2O_2, which is very unstable, sl. sol. in cold H_2O, and insol. in alcohol or ether. (Schöne, A. **192.** 257.)

$+8H_2O$. 100 cc. pure H_2O dissolve 0.168 g. BaO_2+8H_2O; if H_2O contains 0.3 g. $Ba(OH)_2+8H_2O$, only 0.102 g. BaO_2+8H_2O are dissolved; if 0.6 g. $Ba(OH)_2+8H_2O$ only 0.019 g. BaO_2+8H_2O are dissolved. (Schöne, A. 1878, **192.** 266.)

Insol. in acetone. (Eidmann, C. C. **1899,** II. 1014; Naumann, B. 1904, **37.** 4329.)

Barium oxybromide, $Ba(OH)Br+2H_2O$.

Decomp. by H_2O. (Beckmann, J. pr. (2) **27.** 132.)

$BaBr_2,BaO+5H_2O$. Sl. sol. in H_2O. (Tassilly, C. R. 1895, **120.** 1340.)

Barium oxychloride, $Ba(OH)Cl+2H_2O$.

Decomp. by H_2O. (Beckmann, J. pr. (2) **26.** 388, 474.)

Barium mercury oxychloride, $BaCl_2, HgO+6H_2O$.

Decomp. by H_2O. (André, C. R. **104.** 431.)

Barium oxyiodide, $Ba(OH)I+9H_2O$.

Decomp. by H_2O and alcohol. (Beckmann, B. **14.** 2154.)

$BaI_2,BaO+9H_2O$. Sl. sol. in H_2O. (Tassilly, C. R. 1895, **120.** 1340.)

Barium oxysulphides, $Ba_7O_4S_3+58H_2O$, $Ba_2OS+10H_2O$, $Ba_4OS_3+28H_2O$.

Very unstable; decomp. by recrystallization into BaS_2H_2 and BaO_2H_2.

Barium phosphide, BaP_2.

Decomp. by H_2O. (Dumas, A. ch. **32.** 364.)

Ba_3P_2. Crystallized. Sol. in dil. acids; insol. in conc. acids; decomp. by H_2O. Insol. in organic solvents at ord. temp. (Jaboin, C. R. 1899, **129.** 765.)

Barium selenide, BaSe.

Sol. in H_2O with decomp.

Sl. sol. in H_2O. (Favre, C. R. **102.** 1469.)

Barium silicide, Ba_2Si.

(Jüngst, C. C. **1905,** I. 195.)

$BaSi_2$. Slowly decomp. by H_2O, not by NH_4OH+Aq. Rapidly decomp. by conc. NaOH. Sol. in HNO_3, H_2SO_4 and H_3PO_4 with evolution of spontaneously inflammable gas. Sol. in HF and HCl. Sol. in acetic acid without evolution of gas. (Moissan, Traité ch. min. **1904,** III. 680.)

Decomp. rapidly in both hot and cold H_2O. (Bradley, C. N. 1900, **82.** 150.)

Barium sulphide, BaS.

Sol. in H_2O with decomp.

Crystallized. Decomp. by H_2O.

Attacked by cold conc. HNO_3. (Mourlot, A. ch. 1899, (7) **17.** 521.)

Cryst. modification is less readily acted on by air and other reagents than the amorphous modification; sol. in fuse oxidizing agents. (Mourlot, C. R. 1898, **126.** 645.)

$+H_2O$. (Neuberg and Neimann, Biochem. Z. 1906, **1.** 174.)

$+6H_2O$. Slowly sol. in boiling H_2O, with decomp.; insol. in, but decomp. by boiling alcohol. (Schöne.)

Barium sulphide, $Ba_4S_7+25H_2O$ (?).

Sol. in H_2O. (Schöne, Pogg. **112.** 215.)

Barium *tri*sulphide, BaS_3.

Sol. in large amount of boiling H_2O. (Schöne, Pogg. **112.** 215.)

Barium *tetra*sulphide, BaS_4+H_2O.

Easily sol. in H_2O, especially if hot; sol. in 2.42 pts. H_2O at 15°; insol. in CS_2 or alcohol. (Schöne, Pogg. **112.** 224.)

$+2H_2O$. (Veley, Chem. Soc. **49.** 369.)

Barium *penta*sulphide, BaS_5.

Known only in solution.

Barium mercuric sulphide, BaS, $HgS+5H_2O$.

Sol. in H_2O. (Wagner, J. pr. **98.** 23.)

Barium nickel sulphide, BaS, 4NiS.

Sol. in warm conc. HCl. (Bellucci, C. A. **1909,** 293.)

Barium stannic sulphide.

See **Sulphostannate, barium.**

Barium uranyl sulphide, 6BaS, UO_2S+xH_2O (?).

Decomp. by HCl+Aq. (Remelé, Pogg. **124.** 159.)

Baryta.

See **Barium oxide,** BaO.

Beryllium, Be.

For beryllium and its salts, see **Glucinum** and the corresponding salts.

Bismuth, Bi.

Not attacked by H_2O. Very slowly attacked by HCl+Aq (Troost). Very sl. sol. in conc. HCl+Aq (Schützenberger, Willm). Not attacked by dil. HCl+Aq (Naquet and Hanriot). Very slowly attacked by cold HCl+Aq (Godeffroy). According to very careful experiments pure Bi is absolutely unattacked by hot or cold, dil. or conc. HCl+Aq except in presence of oxygen. (Ditte and Metzner, A. ch. (6) **29.** 397.)

Not attacked by dil. H_2SO_4+Aq. Decomp.

by hot conc. H_2SO_4. Easily sol. in dil. or conc. HNO_3+Aq, or aqua regia.

Not attacked by pure HNO_3+Aq of 1.52 to 1.42 sp. gr. at 20°; violently attacked by a more dil. acid, but the acid becomes concentrated thereby. Conc. HNO_3+Aq attacks only by heating or adding NO_2. (Millon, A. ch. (3) **6.** 95.)

Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 827.)

½ ccm. oleic acid dissolves 0.0091 g. Bi in 6 days. (Gates, J. phys. Chem. 1911, **15.** 143.)

Bismuth arsenide, Bi_3As_4.

(Descamp, C. R. **86.** 1065.)

Bismuth *di*bromide, Bi_2Br_4.

Not known in a pure state. (Weber, Pogg. **107.** 599.)

Bismuth *tri*bromide, $BiBr_3$.

Very deliquescent. Decomp. by H_2O. Sol. in alcohol or ether.

Sol. in $AlBr_3$. (Isbekow, Z. anorg. 1913, **84.** 27.)

Bismuth hydrogen bromide, $BiBr_3$, $2HBr+4H_2O$.

Deliquescent.

Decomp. in the air. (Aloy, Bull. Soc. 1906, (3) **35.** 398.)

Bismuth cæsium bromide, $2BiBr_3$, $3CsBr$.

Ppt. Insol. in HBr.

Sol. in HCl and in HNO_3. (Hutchins, J. Am. Chem. Soc. 1907, **29.** 33.)

Bismuth potassium bromide, $BiBr_3$,$2KBr$.

Decomp. by H_2O. (Aloy, Bull. Soc. 1906, (3) **35.** 398.)

Bismuth bromide ammonia, $BiBr_3$, $3NH_3$.

Sol. in HCl+Aq.

$BiBr_3$, $2NH_3$ (?).

$2BiBr_3$, $5NH_3$. Not deliquescent; not decomp. by H_2O; easily sol. in dil. acids. (Muir, Chem. Soc. **29.** 144.)

Bismuth bromide potassium chloride, $K_2BiCl_3Br_2+1½H_2O$.

Decomp. by H_2O. (Atkinson, Chem. Soc. **43.** 289.)

Bismuth *di*chloride, Bi_2Cl_4.

Very deliquescent. Decomp. by H_2O, dil. acids, or conc. NH_4Cl+Aq. (Weber, Pogg. **107.** 596.)

Bismuth *tri*chloride, $BiCl_3$.

Deliquescent. Decomp. by H_2O. Sol. in dil. HCl+Aq, and alcohol. Not decomp. by H_2O in presence of citrates. (Spiller.)

0.08 g. sol. in 100 ccm. liquid H_2S. (Antony, C. C. **1905,** I. 1692.)

Moderately sol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 827.)

1 g. $BiCl_3$ is sol. in 5.59 g. acetone at 18°. Sp. gr. of sat. solution 18°/4°=0.9194. (Naumann, B. 1904, **37.** 4331.)

Sol. in acetone and in methylal. (Eidmann, C. C. **1899,** II. 1014.)

Sol. in benzonitrile. (Naumann, B. 1914, **47.** 1369.)

Sol. in ethyl acetate. (Naumann, B. 1910, **43.** 314.)

1 pt. is sol. in 60.36 pts. ethyl acetate at 18°. Sp. gr at 18°/40°=0.9106. (Naumann, B. 1910, **43.** 320.)

Sol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Bismuth chloride, Bi_3Cl_8 (?).

Decomp. by H_2O. (Dehérain, C. R. **54.** 724.)

Bismuth hydrogen chloride, $2BiCl_3$, $HCl+3H_2O$.

Not deliquescent. Decomp. by H_2O. (Engel, C. R. **106.** 1797.)

$BiCl_3$, 2HCl. (Jacquelain, A. ch. (2) **62.** 363.)

Bismuth cæsium chloride, $BiCl_3$, $3CsCl$.

Decomp. by H_2O. Sl. sol. in cold dil. HCl+Aq, but easily sol. on warming. (Brigham, Am. Ch. J. **14.** 181.)

$2BiCl_3$, $3CsCl$. As above. (Brigham.)

$BiCl_3$, $6CsCl$. Easily sol. in H_2O and dil. HCl+Aq. (Godeffroy, B. **8.** 9.)

Does not exist. (Brigham.)

Bismuth hydrazine chloride, $BiCl_3$, $3N_2H_4HCl$.

Sol. in acids, from which it is pptd. by H_2O. (Ferratini, C. A. **1912.** 1613.)

Bismuth nitrosyl chloride, $BiCl_3$, NOCl.

Very deliquescent. Decomp. by H_2O. (Sudborough, Chem. Soc. **59.** 662.)

Bismuth potassium chloride, $BiCl_3$, $KCl+H_2O$.

Decomp. by H_2O. Cannot be recryst. except from conc. $BiCl_3$+HCl. Decomp. by HCl+Aq into $BiCl_3$, $2KCl+2H_2O$. (Brigham, Am. Ch. J. **14.** 167.)

$BiCl_3$, 2KCl. Decomp. by H_2O. (Arppe, Pogg. **64.** 37.)

Deliquescent.

Sol. in H_2O with decomp. into the oxychloride when excess H_2O is used. (Aloy, Bull. Soc. 1906, (3) **35.** 397.)

$+2H_2O$. Decomp. by H_2O. (Jacquelain, J. pr. **14.** 1.)

Sol. in moderately conc. HCl+Aq.

$BiCl_3$, 3KCl. Decomp. by H_2O. (Arppe.)

Does not exist. (Brigham.)

Bismuth rubidium chloride, $BiCl_3$, $RbCl+H_2O$.

Decomp. by H_2O; sol. in dil. $HCl+Aq$, from which $BiCl_3$, $3RbCl$ crystallizes. (Brigham, Am. Ch. J. **14.** 174.)

$BiCl_3$, $3RbCl$. Decomp. by H_2O; sol. in dil. $HCl+Aq$ without decomp. (Brigham.)

$BiCl_3$, $6RbCl$. Decomp. by H_2O; sol. in $HCl+Aq$ (Godeffroy, B. **8.** 9); does not exist. (Brigham.)

$10BiCl_3$, $23RbCl$ (?). As above. (Brigham.)

Bismuth sodium chloride, $BiCl_3$, $2NaCl+H_2O$.

$+3H_2O$. Decomp. by H_2O. (Arppe, Pogg. **64.** 237.)

$BiCl_3$, $3NaCl$.

Bismuth thallous chloride, $BiCl_3$, $3TlCl$.

Ppt. (Ephraim, Z. anorg. 1909, **61.** 254.)

$BiCl_3$, $6TlCl$. Ppt. (Ephraim.)

Bismuth chloride ammonia, $2BiCl_3$, NH_3.

Stable. (Dehérain, C. R. **54.** 724.)

$BiCl_3$, $2NH_3$. (D.)

$BiCl_3$, $3NH_3$. (D.)

Bismuth chloride nitric oxide, $BiCl_3$, NO.

Very hygroscopic. (Thomas, C. R. 1895, **121.** 129.)

Bismuth chloride nitrogen ***per*****oxide,** $BiCl_3$, NO_2.

Decomp. by moist air, but stable in dry air. (Thomas, C. R. 1896, **122.** 612.)

Bismuth chloride selenide.

See **Bismuth selenochloride.**

Bismuth ***tri*****fluoride,** BiF_3.

Insol. in H_2O or alcohol. (Gott and Muir, Chem. Soc. **53.** 138.)

Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 827.)

Bismuth hydrogen fluoride, BiF_3, $3HF$.

Deliquescent. Decomp. by boiling H_2O. (Muir, Chem. Soc. **39.** 21.)

Bismuth gold, Au_3Bi.

Insol. in equal pts. of HNO_3 and tartaric acids. (Roessler, Z. anorg. 1895, **9.** 71.)

Bismuthous hydroxide, $Bi(OH)_3$.

Sol. in strong acids. Insol. in solutions of alkalies, alkali carbonates, $(NH_4)_2CO_3$, or NH_4NO_3; or of amyl amine (Wurtz). When recently pptd. is sol. in NH_4Cl+Aq, but insol. in NH_4NO_3+Aq (Brett, **1837**). Not pptd. in presence of Na citrates (Spiller).

Solubility of freshly pptd. $Bi(OH)_3$ in $NaOH+Aq$.

g. NaOH per l.	g. Bi dissolved per l. at 20°	g. Bi dissolved per l. at 100°
400	0.16	1.70
320	0.11	1.20
240	0.11	....
200	0.10	0.5
160	0.08	0.5
120	0.07	....
80	0.04	0.35
40	trace	0.2
20	0	0.15

(Moser, Z. anorg. 1909, **61.** 386.)

Solubility of freshly pptd. $Bi(OH)_3$ in $KOH+Aq$.

KOH per l. g.	g. Bi dissolved per l. at 20°	g. Bi dissolved per l. at 100°
560	0.14	1.65
448	0.11	1.20
336	0.11	....
280	0.10	0.5
224	0.08	0.5
168	0.06	....
112	0.03	0.3
56	trace	0.2
28	0	0.15

(Moser, Z. anorg. 1909, **61.** 386.)

Bi_2O_3, $2H_2O$.

Bi_2O_3, H_2O. (Muir, Chem. Soc. **32.** 131.)

See also **Bismuth** ***tri*****oxide.**

Bismuth ***tetra*****hydroxide,** Bi_2O_4, H_2O.

Bi_2O_4, $2H_2O$. (Wernicke, Pogg. **141.** 109.)

Bismuthic hydroxide (Bismuthic acid), Bi_2O_5, H_2O.

Insol. in H_2O; easily decomp. by acids. (Fremy, A. ch. (3) **12.** 495.) Decomp. by H_2SO_4; not attacked by SO_2+Aq; neither dissolved nor decomp. by dil. HNO_3+Aq, but slowly converted into an allotropic modification (?). Partially decomp. by conc. HNO_3. Slowly but wholly dissolved by hot conc. HNO_3. Sl. sol. in conc. $KOH+Aq$. (Arppe.)

Sol. in about 100 pts. boiling $KOH+Aq$, so conc. that it solidifies on removing the lamp. (Muir, Chem. Soc. **51.** 77.)

Bi_2O_5, $2H_2O$. (Bödeker, A. **123.** 61.) Does not exist. (Hoffmann and Geuther.)

Bismuth iodide, BiI_3.

Not attacked by cold H_2O, but by boiling, BiOI is formed. 100 pts. absolute alcohol dissolve 3½ pts. salt at 20°. (Gott and Muir, Chem. Soc. **57.** 138.)

Sol. in HNO_3, and $HI+Aq$, from which it is repptd. by H_2O or alcohol. Sol. in $KI+Aq$ or $KOH+Aq$. (Rammelsberg.)

Sl. sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 827.)

100 g. absolute alcohol dissolve 3.5 g. BiI_3 at 20°. (Gott and Muir, Chem. Soc. **57.** 138.)

Sol. in acetone. (Naumann, B. 1904, **37.** 4328.)

100 pts. methylene iodide dissolve 0.15 pt. BiI_3 at 12°, and very little more at higher temperatures. (Retgers, Z. anorg. **3.** 343.)

Sol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Bismuth hydrogen iodide, BiI_3, $HI+4H_2O$.

(Arppe, Pogg. **44.** 248.)

Bismuth cæsium iodide, $3CsI,2BiI_3$.

Very sl. sol. in H_2O. (Wells, Am. J. Sci. 1897, (4) **3.** 464.)

Bismuth calcium iodide, $2BiI_3$, CaI_2+18H_2O.

Deliquescent; decomp. by H_2O. (Linau, Pogg. **111.** 240.)

Bismuth magnesium iodide, $2BiI_3$, MgI_2+12H_2O.

Deliquescent; decomp. by H_2O. (Linau, Pogg. **111.** 240.)

Bismuth potassium iodide, BiI_3, 4KI.

Ppt. (Arppe, Pogg. **44.** 237.)

BiI_3, 3KI. (Astre, C. R. **110.** 1137.)

BiI_3, 2KI. Sol. in acetic ether. (Astre.)

$+4H_2O$. Sol. in small amt. H_2O without pptn., but decomp. by much H_2O.

BiI_3, 2KI, HI. (Arppe.)

$2BiI_3$, $3KI+2H_2O$. (Astre.)

BiI_3,$KI+H_2O$. Decomp. by H_2O. (Nicklès, C. R. **51.** 1097.)

$2BiI_3$, KI. Sol. in acetic ether. (Astre.)

Bismuth sodium iodide, BiI_3, $NaI+H_2O$.

Deliquescent; decomp. by H_2O. (Nicklès, C. R. **51.** 1097.)

$2BiI_3$, $3NaI+12H_2O$. As above. (Linau, Pogg. **111.** 240.)

Bismuth zinc iodide, $2BiI_3$, ZnI_2+12H_2O.

Very deliquescent. (Linau, Pogg. **111.** 240.)

Bismuth iodide ammonia, BiI_3, $3NH_3$.

Decomp. by H_2O. (Rammelsberg.)

Bismuth iodide zinc bromide.

Sol. in H_2O. (Linau, Pogg. **111.** 240.)

Bismuth nitride.

Explosive. (Fischer, B. 1910, **43.** 1471.)

BiN. Ppt. Decomp. by H_2O or dil. acids. (Franklin, J. Am. Chem. Soc. 1905, **27.** 847.)

Bismuth *di*oxide, Bi_2O_2.

Sol. in conc. HNO_3+Aq. Decomp. by strong acids, and boiling KOH+Aq.

Decomp. by H_2O. (Tanatar, Z. anorg. 1901, **27.** 438.)

Bismuth *tri*oxide, Bi_2O_3.

Insol. in H_2O. Sol. in conc. acids.

Solubility of Bi_2O_3 in HNO_3+Aq at 20°.

In 100 g. of the liquid phase		Solid phase
g. Bi_2O_3	g. N_2O_5	
0.321	0.963	$Bi_2O_3.N_2O_5.2H_2O$
0.337	0.982	"
3.54	4.68	"
6.37	7.17	"
13.67	12.50	"
14.85	13.31	"
18.74	15.90	$Bi_2O_3.N_2O_5.H_2O$
23.50	19.21	"
23.50	19.29	"
27.15	20.96	"
28.11	21.64	"
29.50	22.53	"
30.19	22.90	"
31.48	23.70	"
32.93	24.83	$Bi_2O_3.N_2O_5.H_2O+$
32.80	24.86	$Bi_2O_3.3N_2O_5.10H_2O$.
32.67	24.70	$Bi_2O_3.3N_2O_5.10H_2O$.
32.59	24.60	"
32.24	24.68	"
30.74	25.13	"
29.83	25.30	"
24.16	28.25	"
16.62	35.40	"
12.17	43.37	"
11.66	46.62	"
11.19	49.38	"
11.19	50.20	"
15.20	54.66	"
20.76	53.75	"
27.85	51.02	$Bi_2O_3.3N_2O_5.10H_2O+$ $Bi_2O_3.3N_2O_5.3H_2O$.
8.58	68.28	$Bi_2O_3.3N_2O_5.3H_2O$.
4.05	74.90	"

(Rutten, Z. anorg. 1902, **30.** 386.)

Solubility of Bi_2O_3 in HNO_3+Aq at t°.

t°	% Bi_2O_3	% N_2O_5	Solid phase
9°	20.8	17.1	$Bi_2O_3.N_2O_5.H_2O$
	24.02	19.1	"
	31.09	23.8	$Bi_2O_3.N_2O_5.H_2O+$
	31.2	23.9	$Bi_2O_3.3N_2O_5.10H_2O$
30°	34.2	26.5	"
	28.2	29.6	$Bi_2O_3.3N_2O_5.10H_2O$
	16.1	47.7	"
65°	5.55	7.44	$Bi_2O_3.N_2O_5.H_2O$
	27.62	22.46	"
	40.80	31.60	$Bi_2O_3.N_2O_5.H_2O+Bi_2O_3.3N_2O_5.10H_2O$
	37.82	35.80	$Bi_2O_3.3N_2O_5.10H_2O$
	35.73	47.02	$Bi_2O_3.3N_2O_5.10H_2O+$ $Bi_2O_3.3N_2O_5.3H_2O$
	4.59	77.90	$Bi_2O_3.3N_2O_5.3H_2O$

(Rutten.)

Solubility of Bi_2O_3 in HNO_3+Aq at t°.

t°	%Bi_2O_3	%N_2O_5	Solid phase
72°	37.23	47.76	$Bi_2O_3.3N_2O_5.4H_2O$
75°	36.74	47.91	"
80°	39.75	45.16	"
9°	31.2	23.9	$Bi_2O_3.3N_2O_5.10H_2O$+ $Bi_2O_3.N_2O_5.H_2O$
20°	32.8	24.8	"
30°	34.2	26.4	"
50°	36.9	28.9	"
64°	40.6	31.1	"
65°	40.8	31.6	"
75.5°	45.4	34.6	"
72°	45.9	35.6	"
11.5°	25.36	52.57	$Bi_2O_3.3N_2O_5.10H_2O$+ $Bi_2O_3.3N_2O_5.3H_2O$
20°	27.85	51.02	"
50°	32.22	49.29	"
65°	35.73	47.02	"

(Rutten.)

Solubility in NaOH+Aq at 25°.

Conc. of NaOH Mol/l.	g. Bi_2O_3 in 100 cc. of solution. Mean result.
1.0	0.0013±0.0002
2.0	0.0026±0.0002
3.0	0.0049±0.0005

(Knox, Chem. Soc. 1909, **95.** 1767.)

Insol. in acetone. (Eidmann, C. C. **1899,** II. 1014.)

Min. *Bismite.* Easily sol. in HNO_3+Aq.

See also **Bismuthous hydroxide.**

Bismuth *tetr***oxide,** Bi_2O_4.

Sol. in conc. HCl+Aq, with evolution of Cl; in oxygen acids with evolution of O. Less easily sol. in conc. H_2SO_4 than in HNO_3, or HCl+Aq.

Bismuth oxide, Bi_4O_9 (?).

(Hoffmann and Geuther.)

Bismuth *pent***oxide,** Bi_2O_5.

Sol. in dil. acids. Combines with H_2O to form bismuthic hydroxide, which see. (Hasebroek, B. **20.** 213.)

Bismuth oxybromide, etc.

See **Bismuthyl bromide,** etc.

Bismuth palladium, $PdBi_2$.

Insol. in equal pts. HNO_3 and tartaric acids. (Roessler, Z. anorg. 1895, **9.** 70.)

Bismuth platinum, $PtBi_2$.

Insol. equal pts. HNO_3 and tartaric acids. (Roessler, Z. anorg. 1895, **9.** 69.)

Bismuth phosphide, BiP.

(Cavazzi.)

Bismuth *tri***selenide,** Bi_2Se_3.

Insol. in H_2O, alkalies, or alkali sulphides +Aq; sl. attacked by HCl+Aq; oxidized by HNO_3+Aq. (Schneider, Pogg. **94.** 628.)

Min. *Frenzelite.*

Bismuth potassium selenide.

See **Selenobismuthite, potassium.**

Bismuth selenochloride, BiSeCl.

Not attacked by H_2O; very sl. sol. in HCl+Aq; easily and completely sol. with decomp. in HNO_3+Aq. (Schneider.)

Bismuth *di***sulphide,** $Bi_2S_2+2H_2O$ (?).

Insol. in H_2O. Decomp. by HCl+Aq.

Bismuth *tri***sulphide,** Bi_2S_3.

Insol. in H_2O.

1 l. H_2O dissolves 0.35 x 10^{-6} moles Bi_2S_3 at 18°. (Weigel, Z. phys. Ch. 1907, **58.** 294.)

Easily sol. in moderately dil. HNO_3+Aq, and conc. HCl+Aq, with separation of S. Insol. in alkalies, alkali sulphides, $Na_2S_2O_3$, or KCN+Aq; insol. in NH_4Cl, or NH_4NO_3+Aq (Brett). Insol. in potassium thiocarbonate+Aq. (Rosenbladt, Z. anal. **26.** 15.)

Insol. in alkali hydroxides or alkali hydrosulphides.

Insol. in 2N−$(NH_4)_2S$+Aq.

0.0090 g. Bi_2S_3 is sol. in 100 cc. N−Na_2S_2+Aq at 25°. (Knox, Chem. Soc. 1909, **95.** 1764.)

Somewhat sol. in Na_2S+Aq. 75 cc. of Na_2S+Aq (sp. gr. 1.06) dissolve an amt. of Bi_2S_3 corresponding to 0.031 g. Bi_2O_3. (Stillman, J. Am. Chem. Soc. 1896, **18.** 683.)

Solubility in Na_2S+NaOH+Aq at 25°.

Conc. of Na_2S Mol./l.	Conc. of NaOH Mol./l.	g. Bi_2S_3 in 100 cc. of solution
0.5	1.0	0.0185
1.0	1.0	0.0838

(Knox, Chem. Soc. 1909, **95.** 1763.)

Bismuth sulphide pptd. from acid solution is not dissolved by subsequent treatment with K_2S+Aq. (Stone, J. Am. Chem. Soc. 1896, **18.** 1091.)

Sol. in K_2S+Aq. (Ditte, C. R. 1895, **120.** 187.)

Solubility in K_2S+KOH+Aq at 25°.

Conc. of K_2S Mol./l.	Conc. of KOH Mol./l.	g. Bi_2S_3 in 100 cc. of solution
0.5	1.0	0.0240
1.0	1.0	0.1230
1.25	1.25	0.2354

(Knox, Chem. Soc. 1909, **95.** 1763.)

Solubility in alkali sulphides+Aq at 25°.

Alkali sulphide	Conc. of alkali sulphide Mol./l.	g. Bi_2S_3 in 100 cc. of solution
Na_2S	0.5	0.0040
	1.0	0.0238
	1.5	0.1023
K_2S	0.5	0.0042
	1.0	0.0337
	1.25	0.0639

(Knox, Chem. Soc. 1909, **95.** 1762.)

Decomp. by $FeCl_3$+Aq. (Cammerer, C. C. **1891**, II. 525.)
Insol. in KCN+Aq. (Hoffmann, A. 1884, **223.** 134.)
Min. *Bismuthinite.* Easily sol. in HNO_3+Aq.

Bismuth cuprous sulphide, Bi_2S_3, Cu_2S.
Insol. in H_2O. Sol. with decomp. in HNO_3+Aq. (Schneider, J. pr. (2) **40.** 564.)
Min. *Emplectonite.*

Bismuth potassium sulphide, Bi_2S_3, K_2S.
(Schneider, Pogg. **136.** 460.)
Insol. in ethyl acetate. (Naumann, B. 1910, **43.** 314.)
$Bi_2S_3,4K_2S+4H_2O$. Decomp. by H_2O. Very sol. in K_2S+Aq. Efflorescent in dry air. (Ditte, C. R. 1895, **120.** 186.)
See also **Sulphobismuthite, potassium.**

Bismuth silver sulphide, Bi_2S_3, Ag_2S.
Insol. in cold HCl, or HNO_3. Sol. in warm HNO_3 with separation of S, in boiling HCl with separation of H_2S.
Min. *Plenargyrite, Matildite.*
(Schneider, J. pr. 1890, (2) **41.** 414.)

Bismuth sodium sulphide, Bi_2S_3, Na_2S.
(Schneider.)

Bismuth sulphide telluride, Bi_2S_3, $2Bi_2Te_3$.
Min. *Tetradymite.* Sol. in HNO_3 with separation of S.
Bi_2S_2, $2Bi_2Te$.
Min. *Joseite.* As above.

Bismuth sulphobromide, $BiSBr_2$.
(Muir and Eagles, Chem. Soc. 1895, **67.** 91.)

Bismuth sulphochloride, BiSCl.
Insol. in H_2O or dil. HCl+Aq. Sol. in conc. HCl, or HNO_3+Aq. Decomp. by alkalies+Aq. (Schneider, Pogg. **93.** 464.)

Bismuth sulphoiodide, BiSI.
Not attacked by boiling H_2O, and dil. acids. Decomp. by hot conc. HCl+Aq, and HNO_3+Aq. KOH+Aq dissolves out I_2. (Schneider, Pogg. **110.** 114.)

Bismuth telluride, Bi_2Te_3.
Min. *Tetradymite.* Sol. in HNO_3+Aq.
See also **Bismuth sulphide telluride.**

Bismuthic acid, $HBiO_3$.
See **Bismuthic hydroxide.**

Potassium bismuthate, $KBiO_3$.
Sol. in H_2O. (Arppe.)
$KH(BiO_3)_2$. Insol. in H_2O.
Not decomp. by boiling H_2O. (André, C. R. **113.** 860.)
No salts of $HBiO_3$ can exist. (Muir and Carnegie, Chem. Soc. **51.** 77.)

Bismuthicotungstic acid.

Ammonium bismuthicotungstate, $3(NH_4)_2O$, $2Bi_2O_3$, $11WO_3+10H_2O$.
A yellow oil which dries to a yellow glass. (E. F. Smith, J. Am. Chem. Soc. 1903, **25.** 1232.)

Potassium bismuthicotungstate, $3K_2O$, $2Bi_2O_3,11WO_3+15H_2O$.
A yellow oil which dried to a pale yellow glass. (E. F. Smith, J. Am. Chem. Soc. 1903, **25.** 1233.)

Strontium bismuthicotungstate, 3SrO, $2Bi_2O_3,11WO_3+11H_2O$.
A yellow wax, insol. in pure H_2O, but sol. in H_2O containing a few drops HNO_3. (E. F. Smith, J. Am. Chem. Soc. 1903, **25.** 1233.)

Bismuthyl bromide, BiOBr.
Insol. in H_2O; sol. in moderately conc. HBr+Aq.
Insol. in H_2O. (Herz, Z. anorg. 1903, **36.** 348.)
$Bi_8O_9Br_6$. Insol. in H_2O; easily sol. in conc. HCl, or HNO_3+Aq; less sol. in dil. HNO_3+Aq.
$Bi_{11}O_{13}Br_7$. As the preceding comp. (Muir.)

Bismuthyl chloride, BiOCl.
Insol. in H_2O or dil. acids. Sol. in conc. HCl, or HNO_3+Aq.
Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 827.)
Insol. in acetone. (Naumann, B. 1904, **37.** 4329.)
$+H_2O$. (Heintz, Pogg. **63.** 55.)
$+3H_2O$. (Phillips, Br. Arch. (1) **39.** 41.)
$Bi_7O_9Cl_3$. (Arppe.)
BiO_2Cl_3. Insol. in H_2O; sol. in hot HCl, or HNO_3+Aq. (Muir.)

Bismuthyl fluoride, BiOF.
Insol. in H_2O; sol. in HCl, HBr, or HI+Aq. (Gott and Muir, Chem. Soc. **33.** 139.)
BiOF, 2HF. Insol. in H_2O.

Bismuthyl iodide, BiOI.

Not decomp. by H_2O or alkaline solutions. Sol. in HCl+Aq. Decomp. by HNO_3+Aq. (Schneider, J. pr. **79.** 424.)

Insol. in KCl, or KI+Aq.

$3BiOI,7Bi_2O_3$. Sol. in dil. HCl; decomp. by HNO_3; insol. in boiling H_2O and alkali. (Blyth, C. N. 1896, **74.** 200.)

$BiI_3, 5Bi_2O_3$. Ppt. Sl. sol. in $HC_2H_3O_2$+Aq. Not decomp. by H_2O. (Fletcher and Cooper, Pharm. J. (3) **13.** 254.)

$4BiI_3, 5Bi_2O_3$. Easily sol. in HCl+Aq. Decomp. by HNO_3+Aq. Sl. attacked by H_2SO_4; somewhat sol. in $H_2C_4H_4O_6$, and $KHC_4H_4O_6$+Aq.

Sol. in $(NH_4)_2S$, and KOH+Aq. (Storer's Dict.)

Bismuthyl sulphide, Bi_6O_3S.

(Hermann, J. pr. **75.** 452.)

Bi_2O_3S. Insol. in H_2O. (Scherpenberg, C. C. **1889,** II. 641.)

Bi_4O_3S.

Min. *Karelinite.*

Boracic acid.

See Boric acid.

Borax.

*See Tetra*borate, sodium.

Boric acid, *anhydrous,* B_2O_3.

See Boron *tri*oxide.

*Meta***boric acid,** HBO_2.

Sol. in H_2O.

Sl. sol. in hot glacial acetic acid. (Holt, Chem. Soc. 1911, **100.** (2) 720.)

*Ortho***boric acid,** H_3BO_3.

Sol. in 33 pts. H_2O at 10°.
" 25 " " 20°.
" 3 " " 100°.
(Berzelius.)

Sol. in 20 pts. H_2O at 18.75°. (Abl.)
100 pts. H_2O at 100° dissolve 2 pts. (Ure's Dict.)

1 pt. crystallized acid dissolves in—

25.66 pts. H_2O	at	19°.
14.88 "	"	25°.
12.66 "	"	37.5°.
10.16 "	"	50°.
6.12 "	"	62.5°.
4.73 "	"	75°.
3.55 "	"	87.5°.
2.97 "	"	100°.

Or, 100 pts. H_2O dissolve at—

19°	3.9 pts. H_3BO_3.
25°	6.8 " "
37.5°	7.8 " "
50°	9.8 " "
62.5°	16.0 " "
75°	21.0 " "
87.5°	28.0 " "
100°	34.0 " "

Or, sat. aqueous solution contains at—

19°	3.75% H_3BO_3.
25°	6.27 " "
37.5°	7.32 " "
50°	8.96 " "
62.5°	14.04 " "
75°	17.44 " "
87.5°	21.95 " "
100°	25.17 " "

(Brandes and Firnhaber, Arch. Pharm. **7.** 50.)

1 litre H_2O dissolves at—

0°	19.47 g. H_3BO_3.
12°	29.20 " "
20°	39.92 " "
40°	69.91 " "
62°	114.16 " "
80°	168.15 " "
102°	291.16 " "

(Ditte, C. R. **85.** 1069.)

1 l. H_2O dissolves 0.901 mol. H_3BO_3 at 25°. (Herz, Z. anorg. 1910, **66.** 359.)

1 l. H_2O dissolves 0.898 mol. H_3BO_3 at 25°. Sp. gr. of the solution=1.0168. (Müller, Z. phys. Ch. 1907, **57.** 529.)

1 l. H_2O dissolves 0.887 mol. H_3BO_3 at 25° and 1.025 mol. at 30°. (Ageno and Valla, Ist. Ven. (VIII) **14.** II, 331.)

Solubility in H_2O at t°.

t°	g. H_3BO_3 in 100 g. of the solution
0	2.59
12.2	3.69
21	4.90
31	6.44
40	8.02
50	10.35
60	12.90
69.5	15.58
80	19.11
90	23.30
99.5	28.10
108	36.7
115	45.0
120	52.4

(Nasini and Ageno, Z. phys. Ch. 1909, **69.** 483.)

Solubility curve for orthoboric acid in H_2O at various temp. up to 120°. (Nasini and Ageno, Gazz. ch. it. 1911, **41.** (1) 131.

Sp. gr. of H_3BO_3+Aq sat. at 8°=1.014. (Anthon, A. **24.** 241.)

Sp. gr. of H_3BO_3+Aq sat. at 15°=1.0248. (Stolba, J. pr. **90.** 457.)

Sp. gr. of H_3BO_3+Aq at 15°.

% H_3BO_3	Sp. gr.	% H_3BO_3	Sp. gr.
1	1.0034	4	1.0147
2	1.0069	Sat. sol.	1.015
3	1.0106	...	....

(Gerlach, Z. anal. **28.** 473.)

Sp. gr. of H_3BO_3+Aq at 18°.

$\%H_3BO_3$	0.776	1.92	2.88	3.612
Sp. gr.	1.0029	1.0073	1.0109	1.0131

(Bock, W. Ann. 1887, **30.** 638.)

Volatile with steam.

More sol. in dil. HCl+Aq than in H_2O. Sol. in warm conc. H_2SO_4, HCl, or HNO_3+Aq.

Solubility in HCl+Aq at 25°.

Millimols HCl in 10 ccm. of the solution	Millimols H_3BO_3 in 10 ccm. of the sat. solution
....	9.01
7.0	7.69
13.7	6.66

(Herz, Z. anorg. 1910, **66.** 359.)

Solubility of H_3BO_3 in HCl+Aq at 16°.

Normality of HCl	Normality of H_3BO_3
0.	0.907
0.130	0.895
0.260	0.870
0.390	0.842
1.30	0.645
2.16	0.542
4.32	0.308
6.00	0.338
7.08	0.327
8.74	0.327
9.51	0.338

(Herz, Z. anorg. 1902, **33.** 354.)

Solubility in HF+Aq at 26°.

(1) Titer of HF	(2) Titer after saturation with H_3BO_3 at 26°	(3) Titer after addition of mannitol	(3)–(2) equals free boric acid
3.21n.	1.61	2.36	0.75
2.80n.	1.25(1.40?)	2.21	0.96(0.81?)

The values 0.75 and 0.81 represent the solubility of H_3BO_3 in the concentrations of fluorboric acid resulting from the original concentration of HF+Aq.

(Abegg, Z. anorg. 1903, **35.** 145.)

Solubility of H_3BO_3 in acids+Aq at 26°.

Acid	Normality of the acid	Normality of H_3BO_3
H_2SO_4	0.548	0.746
	2.74	0.518
	5.48	0.312
	8.75	0.092
HNO_3	0.241	0.818
	1.206	0.676
	1.607	0.593
	2.411	0.567
	5.96	0.268
	7.38	0.238

(Herz, Z. anorg. 1903, **34.** 205.)

Solubility in KOH+Aq.
See **Borates, potassium.**
Solubility in NaOH+Aq.
See **Borates, sodium.**

Solubility in LiCl+Aq at 25°.

Millimols LiCl in 10 ccm. of the solution	Millimols H_3BO_3 in 10 ccm. of the sat. solution
....	9.01
7.1	8.13
10.3	7.65
22.3	6.42
37.2	5.02

(Herz, Z. anorg. 1910, **66.** 359.)

Solubility in KCl+Aq at 25°.

Millimols KCl in 10 ccm. of the solution	Millimols H_3BO_3 in 10 ccm. of the sat. solution
....	9.01
1.9	9.20
7.9	9.44
15.6	9.80
30.6	10.75

(Herz.)

Solubility in RbCl+Aq at 25°.

Millimols RbCl in 10 ccm. of the solution	Millimols H_3BO_3 in 10 ccm. of the sat. solution
....	9.01
14.0	9.66
25.3	10.60

(Herz.)

Solubility in NaCl+Aq at 25°.

Millimols NaCl in 10 ccm. of the solution	Millimols H_3BO_3 in 10 ccm. of the sat. solution
....	9.01
8.2	8.49
15.2	8.25
29.4	8.20

(Herz.)

Solubility in H_2O is increased by presence of KCl, KNO_3, K_2SO_4, $NaNO_3$ and Na_2SO_4.

In general the solubility in H_2O is increased by the presence of both electrolytes and non-electrolytes. (Bogdan, C. C. **1903**, II. 2.)

Sol. in borax+Aq. (McLauchlan, Z. anorg. 1903, **37.** 371.)

Sl. sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 827.)

Unattacked and undissolved by liquid NO_2. (Frankland, Chem. Soc. 1901, **79.** 1362.)

Sol. in 6 pts. alcohol (Wittstein), 5 pts. boiling alcohol (Wenzel). Only traces dissolve in anhydrous ether. (Schiff.) Sol. in 100 pts. ether. (Hager's Comm.) Sol. in several essential oils.

1 l. H_2O sat. with amyl alcohol dissolves 0.8952 mol. H_3BO_3 at 25°. (Auerbach, Z. anorg. 1903, **37.** 357.)

Solubility of H_3BO_3 in amyl alcohol+Aq at t°.
M = millimols H_3BO_3 in 1 l. of H_2O.
A = millimols H_3BO_3 in 1 l. of alcohol.

t°	M	A
15°	607.2	176.4
	589.3	177.4
	589.0	177.1
	586.0	173.4
	427.4	127.6
	425.8	127.0
	289.1	84.9
	894.0	264.0
	372.0	110.0
	371.8	110.8
25°	301.2	85.7
	180.8	54.0
	49.15	15.45
	51.04	15.45
	26.02	8.05
35°	146.3	44.27

(Müller, Z. phys. Ch. 1907, **57**. 514.)

Sp. gr. of amyl alcohol+Aq sat. with H_3BO_3.

g. water in 1 l. of alcohol+Aq	d25°/4°
32.481	0.82229
35.465	0.82324
37.339	0.82321
42.479	0.82392
45.175	0.82447
45.636	0.82456
47.883	0.82454
51.461	0.82527
52.043	0.82585
59.270	0.82699
63.179	0.82739
64.254	0.82779
66.403	0.82701
66.624	0.82670
68.253	0.82856
69.211	0.82884
75.610	0.82999(?)

(Müller.)

Solubility of H_3BO_3 in amyl alcohol and NaCl+Aq at 25°.

Water phase		Amyl alcohol phase			
			1 l. contains		
NaCl normality	mol. H_3BO_3	Sp. gr. 25°/4°	mol. H_2O	mol. amyl alcohol	mol. H_3BO_3
0.00	0.880	0.8296	4.10	8.39	0.2640
0.945	0.866	0.8277	3.55	8.49	0.2638
1.490	0.850	0.8268	3.27	8.54	0.2689
1.865	0.844	0.8259	3.03	8.56	0.2724
2.355	0.833	0.8254	2.86	8.59	0.2850
2.845	0.827	0.8247	2.62	8.62	0.2877
3.06	0.810	0.8241	2.39	8.66	0.2891
3.48	0.810	0.8240	2.32	8.69	0.3006
3.57	0.807	0.8236	2.15	8.70	0.3066
4.01	0.801	0.8233	1.99	8.72	0.3162
4.28	0.798	0.8229	1.78	8.75	0.3210

(Müller)

Solubility in hydroxy-compounds+Aq at 25°.

Organic substance added	Mol. of organic substance in 100 mol. of the mixture	Mol. of boric acid sol. in 1 l. of solution	Sp. gr. of the pure mixture	Sp. gr. of the mixture sat. with boric acid
Lactic acid	2.321	1.07	1.0252	1.0444
	6.819	1.61	1.0722	1.0986
	18.77	1.86	1.1405	1.1635
	36.33	2.08	1.2023	1.2254
Glycerine	24.64	1.208	1.1574	1.1707
	46.75	2.132	....	1.2260
	67.71	2.96	1.2370	1.2526
	90.58	3.78	1.2531	1.2710

Solubility in hydroxy-compounds, etc.—*Continued*

Organic substance added	Mol. of organic substance in 100 mol. of the mixture	Mol. of boric acid sol. in 1 l. of solution	Sp. gr. of the pure mixture	Sp. gr. of the mixture sat. with boric acid
Mannitol	0.790	1.007	....	1.0425
	0.810	1.015	1.0244	1.0433
	0.945	1.029	1.0288	....
	1.585	1.136	1.0475	....
Dulcitol	0.065	0.8876	0.9995	1.0686
	0.130	0.9078	1.0018	1.0212
	0.260	0.9360	1.0060	1.0260

(Müller.)

Solubility of H_3BO_3 in alcohols+Aq at 25°.
M = Mol. of alcohol in 100 mol. of alcohol+Aq.
H_3BO_3 = Mol. of H_3BO_3 in 1 l. of the solution.
d_1 = Sp. gr. of alcohol+Aq.
d_2 = Sp. gr. of alcohol+Aq sat. with H_3BO_3.

Alcohol added	M	H_3BO_3	d_1	d_2
Methyl alcohol	11.74	0.895		
	28.64	1.012		
	36.02	1.098		
	43.95	1.161		
	52.31	1.307		
	100	2.900	0.7924	0.8904
Ethyl alcohol	8.996	0.829		
	22.28	0.800		
	44.46	0.729		
	55.62	0.700		
	79.89	0.893		
	88.10	1.105		
	99.26	1.527	0.7860	0.8353
n-Propyl alcohol	23.66	0.6437	0.9043	0.9193
	53.63	0.4569	0.8231	0.8570
	83.65	0.5776	0.8133	0.8466
	100	0.961	0.8010	0.8297
i-Butyl alcohol	0.70	0.884	0.9923	1.0124
	2.15	0.857	0.9853	0.0038
	2.18	0.857	0.9855	0.0046
	71.4	0.323	0.8173	0.8351
	77.1	0.347	0.8133	0.8220
	85.6	0.4212	0.8081	0.8195
	100	0.6927	0.7984	0.8172
i-Amyl alcohol	0.448	0.883	0.9943	1.0132
	0.520	0.880	0.9936	1.0125
	0.525[1]	0.880	0.9931	1.0123
	67.26[2]	0.2584	0.8232	0.829
	75.54	0.2722	0.8183	0.8253
	83.40	0.3190	0.8142	0.8223
	100	0.5703	0.8068	0.8220

[1] Water sat. with alcohol. [2] Alcohol sat. with water.

(Müller.)

Easily sol. in acetone. (Krug and M'Elroy, J. Anal. Ch. **6.** 184.)

Solubility in acetone+Aq at 20°.
A = ccm. acetone in 100 ccm. acetone+Aq.
H_3BO_3 = millimols H_3BO_3 in 100 ccm. of the solution.

A	H_3BO_3
0	79.15
20	81.71
30	83.35
40	82.74
50	81.61
60	76.40
70	67.62
80	55.05
100	8.06

(Herz, Z. anorg. 1904, **41.** 319.)

100 g. pure anhydrous ether dissolve 0.00775 g. H_3BO_3.
100 g. ether sat. with H_2O dissolve 0.2391 g. H_3BO_3.
(J. A. Rose, Dissert. **1902.**)

Sol. in 10 pts. glycerine. (Hager.)

100 pts. glycerine (sp. gr. 1.26 at 15.5°) dissolve pts. H_3BO_3 at t°.

t°	Pts. H_3BO_3	t°	Pts. H_3BO_3	t°	Pts. H_3BO_3
0	20	40	38	80	61
10	24	50	44	90	67
20	28	60	50	100	72
30	33	70	56	..	..

(Hooper, Ph. J, Trans. (3) **13.** 258.)

Solubility of H_3BO_3 in glycerine+Aq at 25°.
G = g. glycerine in 100 g. glycerine+Aq.
H_3BO_3 = Millimols H_3BO_3 in 100 cc. of the solution.

G	H_3BO_3	Sp. gr.
0	90.1	1.0170
7.15	90.1	1.0379
20.44	90.6	1.0629
31.55	92.9	1.0897
40.95	97.0	1.1130
48.7	103.0	1.1328
69.2	140.2	1.1871
100	390.3	1.2719

(Herz, Z. anorg. 1905, **45.** 268.)

Solubility of H_3BO_3 in organic acids+Aq at 26°.

Acid	Normality of the acid	Normality of H_3BO_3
Acetic	0.570	0.887
	2.85	0.538
	5.70	0.268

Solubility of H_3BO_3, etc.—*Continued.*

Acid	Normality of the acid	Normality of H_3BO_3
Tartaric	0.955	0.890
	1.909	0.923
	2.51	0.962
	3.316	1.07

(Herz, Z. anorg. 1903, **34.** 206.)

The solubility of H_3BO_3 in H_2O is increased by the presence of racemic acid.

Millimols racemic acid in 10 ccm. of the solvent	Millimols boric acid in 10 ccm. of the solution
0	9.01
6.3	9.86
12.6	10.46
24.7	11.65

(Herz, Z. anorg. 1911, **70.** 71.)

Solubility of H_3BO_3 in H_2O is increased by the presence of tartaric acid.

Millimols tartaric acid in 10 ccm. of the solvent	Millimols boric acid in 10 ccm. of the solution
0	9.01
7.5	10.00
15	10.70
30	12.07

(Herz, Z. anorg. 1911, **70.** 71.)

Solubility in oxalic acid+Aq at 25°.

Millimols oxalic acid in 10 ccm. of the solution	Millimols H_3BO_3 in 10 ccm. of the sat. solution
....	9.01
2.97	9.95
5.95	10.80
13.77	11.98

(Herz, Z. anorg. 1910, **66.** 93.)

Solubility in H_2O is increased by the presence of urea, acetone or propyl alcohol. (Bogdan, C. C. **1903,** II. 2.)

Readily sol. in hot glacial acetic acid. (Holt Chem. Soc. 1911, **100** (2). 720.)

Sol. in 250 pts. benzene. (Hager.)

Solubility of H_3BO_3 in mannite+Aq at t°.

Solid phase, H_3BO_3

t°	Mg.-mols. in 1 l.		t°	Mg-mols in 1 l.	
	Mannite	H_3BO_3		Mannite	H_3BO_3
25°	0	0.887	30°	0	1.025
"	0.1	0.951	"	0.1	1.056
"	0.3	1.015	"	0.2	1.086
"	0.4	1.039	"	0.3	1.118
"	0.5	1.071	"	0.4	1.157
"	0.6	1.102	"	0.5	0.193
"	0.7	1.142	"	0.6	1.219
"	0.8	1.173	"	0.7	1.258
"	1.043	1.244			
"	1.409	1.404			
"	1.781	1.521			

Solid phase, mannite		
t°	Mg. mols. in 1 l.	
	Mannite	H_3BO_3
25°	1.075	0
"	1.1424	0.2646
"	1.259	0.463
"	1.265	0.559
"	1.354	0.794
"	1.409	0.927
"	1.536	1.243
"	1.781	1.521

(Ageno and Valla, Ist. Ven. (VIII) **14.** 331.)

Distribution between H_2O and amyl alcohol at 25°.

w = concentration of H_3BO_3 in H_2O layer expressed in millimols.

a = concentration of H_3BO_3 in alcohol layer expressed in millimols.

w	a
265.8	76.6
196.5	59.5
159.6	47.5
126	37.1
87.9	33.2
75.2	22.7
64.6	19.76

(Abegg, Z. anorg. 1903, **35.** 130.)

Partition of H_3BO_3 between water and mixtures of amyl alcohol and CS_2.

W = Millimols H_3BO_3 in 10 ccm. of the aqueous layer.

G = Millimols H_3BO_3 in 10 ccm. of the amyl alcohol—CS_2 layer.

Composition of the solvent mixture	G	W	W/G
75% by vol. amyl alcohol+25% by vol. CS_2	0.145	0.624	4.31
	0.275	1.198	4.36
	0.429	1.844	4.30
	0.589	2.565	4.45
50% by vol. amyl alcohol+ 50% by vol. CS_2	0.145	0.756	5.47
	0.259	1.353	5.21
	0.364	1.946	5.34
	0.555	2.889	5.22
25% by vol. amyl alcohol+ 75% by vol. CS_2	0.085	0.699	8.24
	0.175	1.467	8.40
	0.264	2.165	8.12
	0.384	3.129	8.14

(Herz, Z. Elektrochem. 1910, **16.** 870.)

Distribution between HF+Aq and amyl alcohol at 25°.

c = HF concentration (millimols).

a = H_3BO_3 concentration in alcohol layer (expressed in millimols).

w = H_3BO_3 concentration in water layer (expressed in millimols).

c	a	w
500	14.3	71.2
"	19.2	99.2
"	25.3	144.2
"	114.3	979.0
250	30.1	144.5
"	37.0	194.8
"	56.8	321.5
"	108.0	652.0
125	39.0	170.5
"	47.2	214.0
"	52.8	240.5
"	96.0	442.0
62.5	30.4	111.2
"	39.4	151.8
"	65 (68?)	272.8
"	90.0	362.2

(Abegg, Z. anorg. 1903, **35.** 131.)

See also **Boron *tri*oxide.**

***Pyro*boric (*tetra*boric) acid, $H_2B_4O_7$.**

Sol. in H_2O.

Sp. gr. of solutions of boric acid, calculated as $H_2B_4O_7$, containing—

6.3	1.27	1.91	2.54% $H_2B_4O_7$
1.0034	1.0069	1.0106	1.0147 sp. gr.

Sat. solution at 15° has sp. gr. 1.015. (Gerlach, Z. anal. **28.** 473.)

Insol. in hot glacial acetic acid. (Holt, Chem. Soc. 1911, **100.** (2) 720.)

Borates.

No borate is quite insol. in H_2O; the alkali borates are very sol. The less sol. borates are easily decomp. by H_2O; the easily sol. salts are also decomp., but less quickly. The less sol. borates are easily sol. in H_3BO_3, HNO_3, etc. They are more sol. in H_2O containing tartaric acid or potassium tartrate than in pure H_2O. (Souberain.) The normal borates of the alkaline-earths are sol. to no inconsiderable extent in H_2O, and more readily in hot, than in cold H_2O. (Berzelius, Pogg. **34.** 568.)

All borates are insol., or sl. sol. in alcohol.

Aluminum borate, $2Al_2O_3$, B_2O_3.

Min. *Jeremciewite.*

$+3H_2O$. Ppt. (Rose, Pogg. **91.** 452.)

$3Al_2O_3$, B_2O_3. *Crystallized.* Insol. in HNO_3+Aq. (Ebelmen, A. ch. (3) **33.** 62.)

$3Al_2O_3$, $2B_2O_3+7H_2O$. Ppt. (Rose, *l. c.*)

Ammonium borate.

The system $(NH_4)_2O,B_2O_3,H_2O$ at 60° has

been studied by Sborgi. (Real. Ac. Linc. 1915 (5) **24.** I, 1225.)

$2(NH_4)_2O,4B_2O_3+5H_2O$. (Sborgi.)

Ammonium *di*borate.

Difficultly sol. in acetone. (Naumann, B. 1904, **37.** 4328.)

Ammonium *tetra*borate, $(NH_4)_2B_4O_7+4H_2O$, or perhaps $NH_4H(BO_2)_2+1\frac{1}{2}H_2O$.

Sol. in 12 pts. cold H_2O; decomp. by heat. (Rammelsberg, Pogg. **90.** 21.)

Sol. in acetone. (Eidmann, C. C. **1899,** II. 1014.)

$+H_2O$. (Arfvedson.)

Ammonium *octo*borate, $(NH_4)_2B_8O_{13}+6H_2O$.

Sol. in 8 pts. cold, decomp. by boiling H_2O. (Rammelsberg, Pogg. **90.** 21.)

$+4H_2O$.

Min. *Larderellite.* Sol. in H_2O with decomp.

Ammonium *deka*borate, $(NH_4)_2B_{10}O_{16}+6H_2O$.

Permanent. Sol. in H_2O. (Rammelsberg.)

$+8H_2O$. (Atterberg, Bul. ... **22.** 350.)

Ammonium *dodeka*borate, $(NH_4)_2B_{12}O_{19}+9H_2O$.

Sol. in hot H_2O. (Bechi, Sill. Am. J. (2) **17.** 129.)

Ammonium *per*borate, NH_4BO_3.

See **Perborate, ammonium.**

Ammonium calcium borate, $(NH_4)_8CaB_4O_{11} = CaB_4O_7+4(NH_4)_2O$.

(Ditte, C. R. **96.** 1663.)

Ammonium magnesium borate.

Sol. in H_2O, decomp. by boiling. (Rammelsberg, Pogg. **49.** 451.)

Ammonium zinc borate, $4(NH_4)_2B_4O_7, Zn(BO_2)_2+5H_2O$.

(Ditte, C. R. **96.** 1663.)

Barium borate, $Ba(BO_2)_2$.

Ppt. (Ouvrard, C. R. 1906, **142.** 283.)

$+2H_2O$. (Atterberg.)

$+4H_2O$. (Benedikt, B. **7.** 703.)

Sol. in	3,300 pts.	45%	alcohol.
"	7,800	" 50	"
"	25,000	" 60	"
"	55,000	" 75	"

(Berg, Z. anal. **16.** 25.)

...d, more readily in ...nce of ammonium ...l. 568.) Sol. in ...ller.) Insol. in

...y H_2O forming ...ard, C. R. 1906,

$3BaO, B_2O_3$. Easily sol. in mineral acids. Sl. attacked by dil. acetic acid. (Ouvrard, C. R. 1901, **132.** 258.)

BaB_4O_7. Slowly sol. in warm dilute HNO_3+Aq. (Ditte, C. R. **77.** 892.)

$+5H_2O$. Sol. in 100 pts. cold, and more freely in hot H_2O. When freshly pptd. sol. in cold NH_4Cl+Aq (Wackenroder, A. **41.** 315); NH_4NO_3+Aq (Brett, Phil. Mag. (3) **10.** 96); and $BaCl_2$+Aq (Rose).

$BaB_6O_{10}+13H_2O$. (Laurent, A. ch. (2) **67.** 215.)

$Ba_2B_2O_5$. (Bloxam, Chem. Soc. **14.** 143.)

$5BaO, 2B_2O_3$.

$Ba_3B_{10}O_{18}+6H_2O$. Sol. in 100 pts. cold H_2O. Easily sol. in ammonium nitrate, or chloride, or barium chloride+Aq. (Rose, Pogg. **87.** 1.)

$Ba_2B_6O_{11}$. Easily sol. in warm dilute acids.

$+6H_2O$.

$+7H_2O$.

$+15H_2O$. (Laurent, A. ch. (2) **67.** 215.)

Barium borate bromide, $3BaO, 5B_2O_3, BaBr_2$.

(Ouvrard, C. R. 1906, **142.** 283.)

Barium borate chloride, $3BaO,5B_2O_3,BaCl_2$.

Unaffected by H_2O. Sol. in acids. (Ouvrard, C. R. 1906, **142.** 283.)

Bismuth borate, $BiBO_3+2H_2O$.

Ppt. Sl. sol. in H_2O. Decomp. by H_2S. Not decomp. by KOH+Aq. (Vanino, J. pr. 1906, (2) **74.** 152.)

Cadmium borate, $Cd_3(BO_3)_2$.

Insol. in H_2O, easily sol. in dil. acids. (Ouvrard, C. R. 1900, **130.** 174.)

$Cd(BO_2)_2$. Difficultly sol. in H_2O (Stromeyer); insol. in H_2O, sol. in HCl+Aq (Odling); easily sol. in warm NH_4Cl+Aq (Rose). (Guertler, Z. anorg. 1904, **40.** 242.)

$3CdO, 2B_2O_3+3H_2O$. Ppt. Sl. sol. in H_2O. (Rose, Pogg. **88.** 299.)

$CdO, 2B_2O_3+2H_2O$. (Ditte, A. ch. 1883, (5) **30.** 255.)

$CdO, 4B_2O_3+10H_2O$. Sol. in H_2O; decomp. on heating. (Ditte, A. ch. 1883, (5) **30.** 255.)

Cadmium borate bromide, $6CdO, 8B_2O_3, CdBr_2$.

Insol. in H_2O and fuming HCl or HBr+Aq. (Rousseau and Allaire, C. R. 1894, **119.** 72.)

Cadmium borate chloride, $6CdO, 8B_2O_3, CdCl_2$.

(Rousseau and Allaire, C. R. 1894, **118.** 1256.)

Cadmium borate iodide, $6CdO, 8B_2O_3,CdI_2$.

(Allaire, C. R. 1898, **127.** 557.)

Cæsium borate, $Cs_2B_6O_{10}$.

Very sol. in H_2O, less in alcohol. (Reischle, Z. anorg. **4.** 116.)

Calcium borate, $Ca(BO_2)_2$.

Sl. sol. in H_2O; insol. in alkali chlorides, or boiling conc. acetic acid+Aq; sol. in cold or hot solutions of ammonium salts, especially ammonium nitrate, in $CaCl_2$+Aq, and also easily sol. in dilute mineral acids at 50°. (Ditte, C. R. **80.** 490, 561.)

$+2H_2O$.

$+4H_2O$; two modifications of which one is very unstable. (van't Hoff and Meyerhoffer, A. 1906, **351.** 101.)

$+6H_2O$. When warmed in H_2O it goes over into $CaB_2O_4+4H_2O$. (van't Hoff and Meyerhoffer.)

Sol. in H_2O without decomp.; 1 l. solution contains 2 g. salt. (Ditte, C. R. **96.** 1663.)

CaB_4O_7. Decomp. by H_2O. (Blount, C. N. **54.** 208.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

$+3H_2O$. (Ditte, C. R. **96.** 1663.)

$+4H_2O$. Min. *Bechilite.*

$+6H_2O$. Min. *Borocalcite.* Sol. in acids. CaB_6O_{10},$+4H_2O$.

$+8H_2O$. Unstable. On standing in the solution in which it is formed it changes into $CaB_6O_{10}+4H_2O$.

$+12H_2O$. Unstable. Goes over into $CaB_6O_{10}+8H_2O$. (van't Hoff and Meyerhoffer, A. 1906, **351.** 104.)

$CaB_8O_{13}+12H_2O$. (Ditte, C. R. **96.** 1663.)

$2CaO,B_2O_3$. Insol. in H_2O, sol. in dil. acids. (Ouvrard, C. R. 1905, **141.** 353.)

$Ca_2B_6O_{11}$. (Ditte, C. R. **77.** 785.)

$+3H_2O$. Min. *Pandermite, Priceite.* *See* $4CaO, 5B_2O_3+9H_2O$.

$+5H_2O$. Min. *Colemanite.*

If all the Ca is in form of colemanite, the solution contains in 100 g., 4.8 g. H_3BO_3 and 0.1 g. CaO. (van't Hoff, B. A. B. **1907,** 653.)

$+7H_2O$.

$+9H_2O$. (van't Hoff and Meyerhoffer, A. 1906, **351.** 101.)

$3CaO, B_2O_3$. Easily sol. in dil. acids. (Ouvrard, C. R. 1901, **132.** 258.)

$3CaO, 5B_2O_3+9H_2O$. (van't Hoff, B. A. B. **1906,** II. 568.)

$4CaO, 5B_2O_3+9H_2O$. True composition of Pandermite. (van't Hoff, B. A. B. **1906,** II. 572.)

Calcium iron (ferrous) borate silicate, $Ca_2FeB_2Si_2O_{10}$.

Min. *Homilite.* Easily sol. in HCl+Aq.

Calcium magnesium borate, $CaO, MgO, 3B_2O_3+6H_2O$.

Min. *Hydroboracite.* Somewhat sol. in H_2O. Easily sol. in warm HCl+Aq or HNO_3 +Aq.

$3CaO, 3MgO, 4B_2O_3$. (Ditte, C. R. **77.** 894.)

Calcium sodium borate, $2CaO, Na_2O, 5B_2O_3 +8H_2O$.

(van't Hoff, B. A. B. **1907,** 303.

$Ca_3B_{10}O_{18}$, $Na_3B_5O_9$+15, or $24H_2O$.

Min. *Natroborocalcite, Ulexite.* Decomp. by boiling with H_2O. Sol. in acids.

$Ca_2Na_4B_{12}O_{22}+15H_2O$. Min. *Franklandite.* Sl. sol. in H_2O; easily sol. in HCl, and HNO_3+Aq.

Calcium borate bromide, $3CaO, 3B_2O_3, CaBr_2$.

Sl. attacked by H_2O. Very sol. in dilute acetic acid. (Ouvrard, C. R. 1905, **141.** 1023.)

$3CaO, 5B_2O_3, CaBr_2$. Hardly attacked by cold H_2O or very dil. acetic acid. Sol. in strong acids, even when dilute. (Ouvrard, C. R. 1905, **141.** 1023.)

Calcium borate chloride, $Ca_3B_2O_6, CaCl_2$.

Decomp. quickly by moist air or H_2O, slowly by absolute alcohol. (Chatelier, C. R. **99.** 276.)

$3CaO, 3B_2O_3, CaCl_2$. (Ouvrard, C. R. 1905, **141.** 353.)

$3CaO, 5B_2O_3, CaCl_2$. Sl. attacked by cold H_2O and dil. acetic acid+Aq. Strong acids dissolve even when very dilute. (Ouvrard, C. R. 1905, **141.** 352.)

Calcium borate silicate, $2CaO, B_2O_3, 2SiO_2 +H_2O$.

Min. *Datolite.* Sol. in HCl+Aq with separation of gelatinous silica.

$+2H_2O$. Min. *Botryolite.*

CaO, B_2O_3, SiO_2. Min. *Danburite.* Very sl. attacked by HCl+Aq before ignition.

Chromous borate.

Precipitate. Sol. in free acids; insol. in borax+Aq. (Moberg.)

Chromic borate, $7Cr_2O_3, 4B_2O_3$.

Insol. in H_2O; sol. in excess of borax+Aq. (Hebberling, C. C. **1870.** 122.)

Chromic magnesium borate, $3Cr_2O_3, 6MgO, 2B_2O_3$.

Not attacked by acids. (Ebelmen, A. ch. (3) **33.** 52.)

$2Cr_2O_3, 9MgO, 3B_2O_3$. (Mallard, C. R. **105.** 1260.)

Cobaltous borate, $3CoO, 2B_2O_3+4H_2O$.

Sl. sol. in H_2O. (Rose, Pogg. **88.** 299.)

$3CoO, B_2O_3$. (Mallard, C. R. **105.** 1260.)

$2CoO, B_2O_3$. (Ouvrard, C. R. 1900, **130.** 337.)

Cobaltous borate bromide, $6CoO, 8B_2O_3, CoBr_2$.

(Rousseau and Allaire, C. R. 1894, **119.** 73.)

Cobaltous borate chloride, $6CoO, 8B_2O_3, CoCl_2$.

(Rousseau and Allaire, C. R. 1894, **118.** 1257.)

Cobaltous borate iodide, $6CoO, 8B_2O_3, CoI_2$.

(Allaire, C. R. 1898, **127.** 557.)

Cuprous borate, $3Cu_2O, 2B_2O_3$.

(Guertler, Z. anorg. 1904, **38.** 459.)

Cupric borate.

Composition depends on temperature and concentration of solutions. Boiling H_2O dissolves out all the boric acid. Sol. in acids; slowly sol. in hot conc. NH_4Cl+Aq.

$Cu(BO_2)_2$. Insol. in cold dil. acids, even HF. Slowly sol. in hot conc. HCl. Not attacked by alkalies or alkali carbonates+Aq. (Guertler, Z. anorg. 1904, **38.** 456.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Cupric borate ammonia, CuB_4O_7, $4NH_3$+$6H_2O$.

Efflorescent. Can be recrystallized from a little NH_4OH+Aq. (Pasternack, A. **151.** 227.)

Didymium borate, $DiBO_3$.

Insol. in H_2O acidulated with HCl+Aq. (Cleve, Bull. Soc. (2) **43.** 363.)

$Di_2(B_4O_7)_3$. Insol. in H_2O; sol. in acids. (Frerichs and Smith, A. **191.** 355.)

Glucinum borate, basic, 5GlO, B_2O_3.

Insol. in H_2O; sol. in acids. (Krüss and Moraht, B. **23.** 735.)

Iron (ferrous) borate.

Ppt. H_2O dissolves out all the boric acid. (Tünnerman.)

Iron (ferric) borate, $Fe_2(BO_2)_6$+$3H_2O$.

Ppt. Insol. in H_2O.

Min. *Lagonite.* Sol. in acids.

$2Fe_2O_3$, $3B_2O_3$. (Mallard, C. R. **105.** 1260.)

$6Fe_2O_3$, B_2O_3+$6H_2O$. Ppt. (Rose, Pogg. **89.** 473.)

$9Fe_2O_3$, B_2O_3+$9H_2O$. Ppt. (Rose.)

Iron (ferric) magnesium borate, $3Fe_2O_3$, 6MgO, $2B_2O_3$.

Insol. in H_2O. Sol. in conc. HCl+Aq. (Ebelmen, A. ch. (3) **33.** 53.)

$2Fe_2O_3$, 9MgO, $3B_2O_3$. (Mallard, C. R. **105.** 1260.)

Iron (ferroferric) magnesium borate, 3MgO, FeO, Fe_2O_3, B_2O_3.

Min. *Ludwigite.* Slowly sol. in HCl+Aq, when finely powdered.

Iron (ferrous) borate bromide, 6FeO, $8B_2O_3$, $FeBr_2$.

Slowly sol. in hot HNO_3+Aq. (Rousseau and Allaire, C. R. **116.** 1445.)

Iron (ferrous) borate chloride, 6FeO, $8B_2O_3$, $FeCl_2$.

Slowly sol. in hot HNO_3+Aq. (Rousseau and Allaire, C. R. **116.** 1195.)

Lanthanum borate, $2La_2O_3$, B_2O_3.

(Nordenskjöld, Pogg. **114.** 618.)

$La_2(B_4O_7)_3$. Ppt. (Smith.)

Formula is $La_2B_6O_{15}$+xH_2O. (Cleve, B. **11.** 910.)

Lead borate, basic,

2PbO, B_2O_3+$2H_2O$. Ppt.

4PbO, $3B_2O_3$+$4H_2O$. Ppt.

+$5H_2O$. Ppt.

6PbO, $5B_2O_3$+$6H_2O$. Ppt.

8PbO, $3B_2O_3$+$8H_2O$. Ppt.

9PbO, $5B_2O_3$+$9H_2O$. Ppt. (Rose, Pogg. **87.** 470.)

Lead borate, $Pb(BO_2)_2$+H_2O.

Insol. in H_2O. Easily sol. in dil. HNO_3, or boiling $HC_2H_3O_2$+Aq. Decomp. by H_2SO_4, HCl, also by boiling KOH, or NaOH+Aq. Insol. in alcohol. (Herapath, Phil. Mag. (3) **34.** 375.)

Sol. in NH_4Cl+Aq; sol. in sat. NaCl+Aq.

2PbO, $3B_2O_3$+$4H_2O$. (Herapath.)

PbB_4O_7+$4H_2O$. Slightly sol. in pure H_2O, but insol. in solutions of Na salts as $Na_2B_4O_7$ +Aq. (Soubeiran.)

Lead borate chloride, $Pb(BO_2)_2$, $PbCl_2$+H_2O.

Insol. in cold, very slowly decomp. by hot H_2O into its constituents. Easily sol. in dil. hot HNO_3+Aq; insol. in alcohol. (Herapath, Phil. Mag. (3) **34.** 375.)

Lead borate nitrate, $Pb(BO_2)_2$, $Pb(NO_3)_2$+H_2O.

Insol. in alcohol. (Herapath.)

Lithium borate, $LiBO_2$.

Solubility in H_2O.

100 g. H_2O dissolve g. $LiBO_2$ at t°.

t°	g. $LiBO_2$	t°	g. $LiBO_2$
0	0.7	30	4.9
10	1.4	40	11.12
20	2.6	45	20.

(Le Chatelier, C. R. 1897, **124.** 1094.)

Insol. in acetone. (Eidmann, C. C. **1899,** II. 1014; Naumann, B. 1904, **37.** 4329.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Insol. in ethyl acetate. (Naumann, B. 1910, **43.** 314.)

+$8H_2O$. (Le Chatelier, Bull. Soc. 1899, (3) **21.** 35.)

+$16H_2O$. Effloresces in the air; slowly sol. in cold H_2O, rapidly in hot H_2O. (Le Chatelier, C. R. 1897, **124.** 1092.)

$Li_2H_4(BO_3)_2$+$14H_2O$. (Reischle, Z. anorg. **4.** 166.)

$Li_2B_4O_7$. Deliquescent; easily sol. in H_2O. (Arfvedson, A. ch. **10.** 82.)

Sol. in acetone. (Eidmann, C. C. **1899,** II. 1014.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

+$5H_2O$. Insol. in alcohol. (Filsinger, Arch. Ph. (3) **8.** 198.)

$Li_2O, 3B_2O_3+6H_2O$. Very sol. in H_2O; insol. in alcohol. (Filsinger.)

$Li_2O, 4B_2O_3$. Insol. in H_2O. (Le Chatelier, Bull. Soc. 1899, (3) **21.** 35.)

$+10H_2O$. Sol. in H_2O; insol. in alcohol. (Filsinger.)

"Acid lithium borate" is less sol. than the tetraborate. (Gmelin.)

$Li_2O, 5B_2O_3+10H_2O$. (Dukelski, C. A. **1908.** 1089.

Magnesium borate, $Mg(BO_2)_2$.

(Ditte, C. R. **77.** 893.)

$+3H_2O$. Min. *Pinnoite.*

$+4H_2O$. (Laurent, A. ch. (2) **67.** 215.)

$+8H_2O$. Insol. in cold or hot H_2O; easily sol. in HCl+Aq. Decomp. by conc. HCl +Aq into H_3BO_3 and $MgCl_2$. (Wöhler.)

$MgB_4O_7+8H_2O$. (Popp, A. Suppl. **8.** 1.)

$MgO, 3B_2O_3+8H_2O$. Very slowly sol. in H_2O. (Rose, A. **84.** 221.)

Sol. in 75 pts. cold H_2O. (Rammelsberg, Pogg. **49.** 445.)

$2MgO, B_2O_3$. Insol. in H_2O, but sol. in Na_2CO_3+Aq. (Guertler, Z. anorg. 1904, **40.** 236.)

$+H_2O$. Very sl. sol. in $^1/_{10}$ N HCl+Aq. (van't Hoff, B. A. B. **1907,** 658.)

Min. *Ascharite.*

$3MgO, B_2O_3$. Insol. in H_2O; easily sol. in acids. (Ebelmen, A. **80.** 208.)

Very sl. sol. in cold, but somewhat decomp. by boiling H_2O. (Rammelsberg.)

$+9H_2O$. Somewhat sol. in cold H_2O. (Wöhler, Pogg. **28.** 525.)

$3MgO, 2B_2O_3$. Sol. in warm H_2SO_4 or HNO_3+Aq. (Ditte, C. R. **77.** 893.)

$MgO, 6B_2O_3+18H_2O=Mg(BO_2)_2, 10HBO_2 +13H_2O$. (Rammelsberg, Pogg. **49.** 445.)

$3MgO, 4B_2O_3$. Sol. in hot dil. acids; insol. in acetic acid. (Ditte, C. R. **77.** 893.)

$5MgO, 2B_2O_3+1\frac{1}{2}$, and $3H_2O$. Min. *Szaibelyite.* Difficultly sol. in HCl+Aq.

$9MgO, B_2O_3$. (Mallard, C. R. **105.** 260.)

Magnesium manganous borate, $3Mg_2B_2O_5, 4Mn_2B_2O_5+7H_2O$.

Min. *Sussexite.* Sol. in HCl+Aq.

Magnesium potassium borate, $KMg_2B_{11}O_{19}+9H_2O$.

Min. *Kaliborite.* Insol. in H_2O. (Feit, Ch. Z. 1889, **13.** 1188.)

$2MgO, 2K_2O, 11B_2O_3+20H_2O$. (van't Hoff and Lichtenstein, B. A. B. **1904,** 936.)

Magnesium sodium borate, $Mg_2B_6O_{11}, Na_2B_4O_7+30H_2O$.

Efflorescent. About as sol. in cold H_2O as borax; solution separates out a Mg borate on warming, which redissolves on cooling. Decomp. by boiling H_2O. (Rammelsberg.)

Magnesium strontium borate, $3MgO, 3SrO, 4B_2O_3$.

Easily sol. in dil. acids. (Ditte, C. R. **77.** 895.)

Magnesium borate bromide, $2Mg_3B_8O_{15}, MgBr_2$ or $6MgO, 8B_2O_3, MgBr_2$.

(Rousseau and Allaire, C. R. **1894,** 119, 71.)

Magnesium borate chloride, $2Mg_3B_8O_{15}, MgCl_2$.

Min. *Boracite.* Insol. in H_2O; slowly sol. in acids. (Kraut.)

Stassfurthite. Easily sol. in warm acids. (Bischof.)

Magnesium borate iodide, $6MgO, 8B_2O_3, MgI_2$.

(Allaire, C. R. 1898, **127.** 556.)

Magnesium borate phosphate, $Mg(BO_2)_2, 2MgHPO_4+7H_2O$.

Min. *Luneburgite.*

Magnesium borate sulphate, $2Mg_3B_4O_9, 3MgSO_4+12H_2O$.

Min. *Magnesium sulphoborite.*

Sol. in mineral acids when ground. (Naupert, B. 1893, **26.** 874.)

Manganous borate, MnB_4O_7 (?).

Insol. in H_2O (Berzelius); very sl. sol. in H_2O (Thomas, Am. Ch. J. **4.** 358); decomp. by warm, slowly by cold H_2O. Sol. in $MgSO_4$ +Aq (Berzelius).

$+3H_2O$. (Endemann and Paisley, Zeit. angew. Ch. 1903, **16.** 176.)

$+5H_2O$. Ppt. (Endemann and Paisley.)

Very hydroscopic. (Endemann, Am. Ch. J. 1903, **29.** 72.)

$3MnO, B_2O_3$. (Mallard, C. R. **105.** 1260.)

Not attacked by H_2O. Very sol. in acids. (Ouvrard, C. R. 1900, **130.** 336.)

$3MnO, 2B_2O_3$. (Mallard.)

$MnH_4(BO_3)_2$. Very sl. sol. in H_2O.

Solubility in 2% Na_2SO_4+Aq. At 18.5°, 0.77 g. $MnH_4(BO_3)_2$ are dissolved per litre; at 40°, 0.65 g.; at 60°, 0.36 g.; at 80°, 0.12 g.

Solubility in 2% NaCl+Aq. 1 l. solution dissolves 1.31 g. salt at 18.2°; 0.6 g. at 59°; and 0.29 g. at 80°.

Solubility in 2% $CaCl_2$+Aq. 1 l. $CaCl_2$+Aq dissolves 2.91 g. salt at 17.6°; 2.44 g. at 43.0°; 2.25 g. at 61°; and 1.35 g. at 80°. (Hartley and Ramage, Chem. Soc. **63.** 129.)

Manganous borate bromide, $6MnO, 8B_2O_3, MnBr_2$.

(Rousseau and Allaire, C. R. 1894, **119.** 73.)

Manganous borate chloride, $6MnO, 8B_2O_3, MnCl_2$.

(Rousseau and Allaire, C. R. 1894, **118.** 1257.)

Molybdenum borate, $MoO_2, 2B_2O_3$ (?).

Insol. in H_2O; sol. in H_3BO_3+Aq. (Berzelius.)

Molybdenum borate, Mo_2O_3, B_2O_3.

Precipitate. Insol. in H_2O; sl. sol. in a solution of boric acid. (Berzelius.)

See **Boromolybdic Acid.**

Nickel borate, $Ni(BO_2)_2+2H_2O$.

Insol. in H_2O. Easily sol. in acids. Easily sol. in warm NH_4Cl+Aq. (Rose, Pogg. **88.** 299.)

$2NiO$, $B_2O_3+xH_2O$. Easily sol. in acids. (Rose.)

$3NiO$, $2B_2O_3+5H_2O$. Easily sol. in acids. (Rose.)

$3NiO,B_2O_3$. Not attacked by H_2O; sol. in acids. (Ouvrard, C. R. 1900, **130.** 337.)

Nickel borate bromide, $6NiO$, $8B_2O_3$, $NiBr_2$.

(Rousseau, C. R. 1894, **119.** 73.)

Nickel borate chloride, $6NiO,8B_2O_3,NiCl_2$.

(Rousseau, C. R. 1894, **118.** 1257.)

Potassium borates.

Solubility of B_2O_3 in K_2O+Aq at 30°.

Solution contains		Solid phase
% by wt. K_2O	% by wt. B_2O_3	
47.50	.....	$KOH, 2H_2O$
46.45	0.72	"
46.36	0.91	$K_2O, B_2O_3, 2.5H_2O$
40.51	1.25	"
36.82	1.80	"
36.72	1.85	"
32.74	3.51	"
29.63	6.98	"
26.89	12.12	"
24.84	17.63	"
23.30	18.19	$K_2O, 2B_2O_3, 4H_2O$
16.21	13.10	"
11.78	9.82	"
9.18	8.00	"
6.22	9.13	"
7.79	13.20	"
7.73	13.37	$K_2O, 2B_2O_3, 4H_2O+K_2O, 5B_2O_3, 8H_2O$
7.81	13.28	"
7.67	13.19	"
7.71	13.21	$K_2O, 5B_2O_3, 8H_2O$
7.63	13.28	"
3.42	7.59	"
1.80	4.15	"
0.80	3.05	"
0.51	3.19	"
0.33	4.58	$K_2O, 5B_2O_3, 8H_2O+B(OH)_3$
0.38	4.51	"
0.31	4.46	"
0.28	4.36	$B(OH)_3$
.....	3.54	"

At 30° only the three potassium borates K_2O, $B_2O_3+2.5H_2O$; K_2O, $2B_2O_3+4H_2O$ and K_2O, $5B_2O_3+8H_2O$ exist in stable form.

(Dukelski, Z. anorg. 1906, **50.** 42.)

Potassium ***meta*****borate,** KBO_2.

Sol. in small amount of H_2O. (Berzelius, Pogg. **34.** 568.)

$+1\frac{1}{4}H_2O$. Only stabile hydrate. (Dukelski, Z. anorg. 1906, **50.** 42.)

$+1\frac{1}{2}H_2O$. (Atterberg, Bull. Soc. (2) **22.** 350.)

Potassium ***tetra*****borate,** $K_2B_4O_7$.

Very sol. in H_2O.

$+4H_2O$. (Atterberg, Bull. Soc. (2) **22.** 350.)

Only stabile hydrate. (Dukelski, *l. c.*)

$+5H_2O$. Very sol. in H_2O; more sol. than $K_2B_6O_{10}$ or $K_2B_{12}O_{19}$.

$+6H_2O$. (Atterberg, *l. c.*)

Potassium ***hexa*****borate,** $K_2B_6O_{10}+5$, and $8H_2O$.

Easily sol. in H_2O.

Does not exist. (Dukelski, *l. c.*)

Potassium ***deka*****borate,** $K_2B_{10}O_{16}+8H_2O$.

Sol. in H_2O. (Rammelsberg.)

Only hydrate. (D[illegible])

Potassium ***dodeka*****borate,** $K_2B_{12}O_{19}+10H_2O$.

Sl. sol. in cold, very sol. in hot H_2O. (Laurent, A. ch. **67.** 215.)

$=K_2B_{10}O_{16}$. (Rammelsberg.)

Does not exist. (Dukelski.)

Potassium borate fluoride, KBO_2, KF.

Sol. in H_2O. (Schiff and Sestini, A. **228.** 72.)

KBO_2, $2KF$. Sol. in little, decomp. by much H_2O. Insol. in H_2O. (Schiff and Sestini, A. **228.** 72.)

Rubidium borate, $Rb_2B_4O_7$.

Anhydrous. (Reischle, Z. anorg. **4.** 166.)

$+6H_2O$. Not deliquescent or efflorescent. Sol. in H_2O. (Reissig, A. **127.** 33.)

Samarium borate, $SmBO_3$.

Insol. in H_2O; sol. in HCl+Aq. (Cleve, Bull. Soc. (2) **43.** 1670.)

Scandium borate, $ScBO_3$.

Sol. in dil. acids. (Crookes, Phil. Trans. 1910, **210.** A. 364.)

Silver borate, $AgBO_2$.

Sl. sol. in H_2O. By washing with H_2O the boric acid is dissolved out. (Rose, Pharm. Centralbl. **1853.** 205.)

Sol. with decomp. in $Na_2S_2O_3$+Aq (Herschel); sol. in NH_4NO_3+Aq if pptd. cold.

1 l. H_2O dissolves ca. 6×10^{-2} gram-atoms at 25°. (Abegg and Cox, Z. phys. Ch. 1903, **46.** 11.)

Insol. in ethyl acetate. (Naumann, B. 1910, **43.** 314.)

$3Ag_2O$, $4B_2O_3$. (Rose, *l. c.*)

Sodium borates.

Solubility of B_2O_3 in Na_2O+Aq at 30°.

Solution contains % by wt. Na_2O	% by wt. B_2O_3	Solid phase
42.00	.....	NaOH, H_2O
40.85	2.71	"
41.37	5.10	"
38.85	5.55	$Na_2O, B_2O_3, 4H_2O$
34.44	3.73	"
29.39	2.51	"
28.61	2.38	"
27.78	2.44	"
26.13	2.75	"
25.08	2.98	"
23.00	3.82	"
16.61	13.69	"
21.58	4.63	$Na_2O, B_2O_3, 4H_2O+Na_2O, B_2O_3, 8H_2O$
20.58	4.69	$Na_2O, B_2O_3, 8H_2O$
18.31	4.97	"
15.32	6.21	"
13.25	8.18	"
12.39	9.12	"
8.85	10.49	$Na_2O, 2B_2O_3, 10H_2O$
5.81	6.94	"
4.00	4.76	"
1.88	2.41	"
1.38	5.16	"
1.84	7.36	"
2.02	7.79	"
2.40	9.48	"
4.08	17.20	$Na_2O, 2B_2O_3, 10H_2O+Na_2O, 5B_2O_3, 10H_2O$
3.79	15.84	$Na_2O, 5B_2O_3, 10H_2O$
3.47	13.30	"
2.26	12.14	"
1.99	11.84	$Na_2O, 5B_2O_3, 10H_2O+B(OH)_3$
1.86	11.78	$B(OH)_3$
1.81	11.18	"
0.64	6.11	"
.....	3.54	"

At 30°, only the four sodium borates $Na_2O, B_2O_3+4H_2O$; $Na_2O, B_2O_3+8H_2O$; $Na_2O, 2B_2O_3+10H_2O$; and $Na_2O, 5B_2O_3+10H_2O$ exist as stable phases.

(Dukelski, Z. anorg. 1906, **50.** 46.)

Sodium *meta*borate, $NaBO_2$.

Anhydrous. Easily sol. in H_2O, with evolution of heat.

$+H_2O$. Easily sol. in H_2O. (Benedikt.)

$+2H_2O$. Easily sol. in H_2O. (Benedikt, B. **7.** 703.)

$+3H_2O$. Easily sol. in H_2O. (Berzelius.)

$+4H_2O$. Sl. efflorescent. Sol. in hot, less sol. in cold H_2O. Melts at 57° in its crystal H_2O. (Dukelski, Z. anorg. **50.** 42.)

$+4\frac{1}{2}H_2O$. (Atterberg, Z. anorg. 1906, **48.** 370.)

$+5\frac{1}{2}H_2O$. (Atterberg.)

$+8H_2O$. (Atterberg.)

$+4H_2O$ and $+8H_2O$ are the only hydrates formed. (Dukelski.)

System Na_2O, B_2O_3, H_2O at 60° investigated by Sborgi. (Real. Ac. Linc. 1915, (5) **24.** I, 443.)

Sodium *tetra*borate, $Na_2B_4O_7$ (*Borax*).

100 g. H_2O dissolve at:

5°	10°	21.5°	30°	37.5°		
1.3	1.6	2.8	3.9	5.6 g. anhydrous salt.		
45°	50°	54°	55°	56°	57°	
8.1	10.5	13.3	14.2	15.0	16.0 g. anhydrous salt.	

(Horn and van Wagener, Am. Ch. J. 1903, **30.** 347.)

Insol. in ethyl acetate. (Naumann, B. 1910, **43.** 314.)

Sol. in amyl alcohol in the presence of meta-arsenious acid and excess of H_3BO_3. (Auerbach, Z. anorg. 1903, **37.** 358.)

$+4H_2O$.

$+5H_2O$.

100 g. H_2O dissolve at:

65°	70°	80°	90°	100°
22.0	24.4	31.4	40.8	52.3 g. anhydrous salt.

(Horn and van Wagener, Am. Ch. J. 1903, **30.** 347.)

$+6H_2O$. Grows opaque in the air. (Bechi, Sill. Am. J. (2) **17.** 129.)

$+10H_2O$. Only stabile hydrate. (Dukelski, Z. anorg. **50.** 30.) Efflorescent on surface in dry air. Not efflorescent when free from Na_2CO_3. (Sims.)

Sol. in 12 pts. cold, and 2 pts. hot H_2O. Sat. cold $Na_2B_4O_7$+Aq contains 9.23%, and sat. hot $Na_2B_4O_7$+Aq contains 33.33% $Na_2B_4O_7$. (Gmelin.)

Sol. in 20 pts. cold. and 6 pts. boiling H_2O. (Wallerius.)

Sol. in 15 pts. H_2O at 18.75°. (Abl.)

100 pts. H_2O at 15.5° dissolve 5 pts.; at 65°, 40 pts.; at 100°, 166 pts. $Na_2B_4O_7+10H_2O$. (Ure's Dictionary.)

100 pts. sat. $Na_2B_4O_7$+Aq at 105.5° contain 52.5 pts. $Na_2B_4O_7$, or 100 pts. H_2O dissolve 110.54 pts. $Na_2B_4O_7$, or 1 pt. $Na_2B_4O_7$ is sol. in 0.9047 pt. H_2O at 105.5°. (Griffith, Quar. J. Sci. **18.** 90.)

Solubility in 100 pts. H_2O at t°.

t°	Pts. $Na_2B_4O_7$	Pts $Na_2B_4O_7+10H_2O$	t°	Pts. $Na_2B_4O_7$	Pts. $Na_2B_4O_7+10H_2O$
0	1.49	2.83	60	18.09	40.43
10	2.42	4.65	70	24.22	57.85
20	4.05	7.88	80	31.17	76.19
30	6.00	11.90	90	40.14	116.66
40	8.79	17.90	100	55.16	201.43
50	12.93	27.41	...	...	....

(Poggiale, A. ch. (3) **8.** 46.)

100 pts. H_2O dissolve 1.4 pts. $Na_2B_4O_7$ at 0°, and 55.3 pts. at 100°. (Mulder.)

$Na_2B_4O_7$+Aq sat. at 15° has sp. gr. = 1.0199, and contains 3.926 pts. $Na_2B_4O_7$ to 100 pts. H_2O. (Michel and Krafft, A. ch. (3) **41.** 471.)

$Na_2B_4O_7+Aq$ sat. at 17° has sp. gr.= [illegible] J. pr. **97.** 503.)

Sp. gr. of $Na_2B_4O_7+Aq$ at 15°.

% $Na_2B_4O_7$	% $Na_2B_4O_7+10H_2O$	Sp. gr.	% $Na_2B_4O_7$	% $Na_2B_4O_7+10H_2O$	Sp. gr.
1	0.52	1.0049	4	2.11	1.0199
2	1.06	1.0099	5	2.64	1.0249
3	1.59	1.0149	6	3.17	1.0299

(Gerlach, Z. anal. **28.** 473.)

Sp. gr. of $Na_2B_4O_7+Aq$ sat. at 15° = 1.032. (Gerlach.)

Sat. $Na_2B_4O_7+Aq$ boils at 105.5°, and contains 110.5 pts. $Na_2B_4O_7$ to 100 pts. H_2O. (Griffith.)

Sat. $Na_2B_4O_7+Aq$ forms a crust at 103°, and contains 60.14 pts. $Na_2B_4O_7$ to 100 pts. H_2O; highest temp. observed, 104.3°. (Gerlach, Z. anal. **26.** 427.)

B.-pt. of $Na_2B_4O_7+Aq$ containing pts. $Na_2B_4O_7$ to 100 pts. H_2O.

B.-pt.	Pts. $Na_2B_4O_7$	B.-pt.	Pts. $Na_2B_4O_7$
100.5°	8.64	103.0°	61.2
101.0	17.2	103.5	75.4
101.5	26.5	104.0	90.8
102.0	37.5	104.5	109.0
102.5	48.5	104.6	112.3

(Gerlach, Z. anal. **26.** 452.)

M.-pt. of $Na_2B_4O_7+10H_2O$ is 75.5°. (Tilden, Chem. Soc. **45.** 407.)

Insol. in alcohol.

100 g. alcohol (0.941 sp. gr.) dissolve 2.48 g. at 15.5° (U. S. P.).

Sol in alcoholic solution of $NaC_2H_3O_2$. (Stromeyer.)

Sol. in 14.7 pts. glycerine of 1.225 sp. gr. (Vogel.)

Sol. in 1 pt. glycerine. (Schultze, Arch. Pharm. (3) **6.** 149.)

100 g. glycerine dissolve 60.3 g. at 15.5° (U. S. P.)

Min. *Tincal.*

Sodium borate, $Na_2B_8O_{13}+10H_2O$.

Sol. in 5–6 pts. cold H_2O. (Bolley, A. **68.** 122.) Perhaps sodium hydrogen tetraborate $NaHB_4O_7+4\frac{1}{2}H_2O$.

$Na_2B_{10}O_{16}+10H_2O$. Decomp. by H_2O. (Atterberg, Z. anorg. **48.** 370.)

Stabile. (Dukelski, Z. anorg. **50.** 42.)

$+11H_2O$. (Laurent, C. R. **29.** 5.)

Sodium borate fluoride, $NaBO_2$, $3NaF+4H_2O$.

Sol. in H_2O.

Basarow (B. **7.** 112) considers this salt to be a mixture.

$Na_2B_4O_7$, $12NaF+22H_2O$. Can be separated into its constituents by H_2O. (Berzelius, Berz. J. B. **23.** 96.)

Strontium borate, $Sr(BO_2)_2$.

(Ditte, C. R. **77.** 788.)

Easily hydrated by H_2O forming SrO, $B_2O_3+2H_2O$. Very sol. in dil. acetic acid. (Ouvrard, C. R. 1906, **142.** 282.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329.)

$+2H_2O$. (Ouvrard, *l. c.*)

$+4H_2O$. (Ouvrard, *l. c.*)

$+5H_2O$. 1 l. H_2O dissolves 2.3 g. at 10°. (Ditte, A. ch. 1883 (5) **30.** 253.)

SrB_4O_7. Insol. in H_2O; sol. in dil. acids. (Guertler, Z. anorg, 1904, **40.** 243.)

$+4H_2O$. Sol. in 130 pts. boiling H_2O. 100 pts. H_2O at 100° dissolve 7.7 pts. (Ure's Dict.). Easily sol. in cold NH_4 salts+Aq; sol. in cold HNO_3+Aq.

$2SrO,B_2O_3$. Easily decomp. by H_2O forming B_2O_3, SrO, $4H_2O$. Very sol. in acids. (Ouvrard, C. R. 1906, **142.** 282.)

3SrO, B_2O_3. Less easily attacked by H_2O than Ca comp. Very sol. in mineral acids. Sl. attacked by dil. acetic acid. (Ouvrard, C. R. 1901, **132.** 258.)

SrB_6O_{10}. Very sl. sol. in H_2O; sol. in acids. (Laurent.)

$SrB_8O_{31}+7H_2O$. Ppt. (Laurent.)

$+12H_2O$. (Ditte.)

$Sr_3B_4O_9$. Sol. in cold mineral acids and acetic acid. (Ditte, C. R. **77.** 785.)

2SrO, $3B_2O_3$. Easily sol. in acids. (Ditte, *l. c.*)

Strontium borate bromide, 3SrO, $5B_2O_3$, $SrBr_2$.

As the chloride. (Ouvrard, C. R. 1906, **142.** 283.)

Strontium borate chloride, 3SrO, $5B_2O_3$, $SrCl_2$.

Sl. attacked by cold H_2O, not attacked by dilute acetic acid. (Ouvrard, C. R. 1906, **142.** 282.)

Thallous borate, $TlBO_2+\frac{1}{2}H_2O$.

Decomp. in the air. (Buchtala, J. pr. 1913, (2) **88.** 784.)

$Tl_2B_2O_7$. (Buchtala.)

$Tl_2B_4O_7$. Ppt. Sol. in boiling H_2O; insol. in cold dil. H_2SO_4+Aq. (Crookes.)

$+2H_2O$. (Buchtala, J. pr. 1913 (2) **88.** 774.)

$Tl_2B_6O_{10}+3H_2O$. (Buchtala.)

$Tl_2B_8O_{13}+4H_2O$. (Buchtala.)

$Tl_2B_{10}O_{16}+8H_2O$. (Buchtala.)

$Tl_2B_{12}O_{19}+7H_2O$. (Buchtala.)

Thorium borate (?).

Precipitate. Insol. in H_2O and H_3BO_3+Aq. (Berzelius.)

Tin (stannous) borate (?).

Ppt. (Wenzel.)

*Di*vanadyl borate.
Insol. in H_2O; sol. in H_3BO_3+Aq. (Berzelius.)

Ytterbium borate, $YbBO_3$.
Insol. in conc. HCl; sol. in HF. (Cleve, Z. anorg. 1902, **32.** 148.)

Yttrium borate.
Precipitate. (Berlin, Pogg. **43.** 105.)

Zinc borate, $3ZnO, 2B_2O_3$.
(Mallard, C. R. **105.** 1260.)
Decomp. by H_2O; very sol. in dil. acids. (Ouvrard, C. R. 1900, **130.** 336.)
$ZnO, 2B_2O_3+4H_2O$. Sol. in H_2O with decomp. (Ditte, A. ch. 1883, (5) **30.** 256.)
$3ZnO, 4B_2O_3+H_2O$. Ppt. (Holdermann, Arch. Pharm. 1904, **242.** 567.)
$ZnO, 4B_2O_3+10H_2O$. (Ditte, A. ch. 1883, (5) **30.** 256.)
$9ZnO, 4B_2O_3+9H_2O$. Sl. sol. in H_3BO_3 +Aq. (Rose, Pogg. **88.** 299.)
$3ZnO, B_2O_3$. Insol. in mineral acids. (le Chatelier, C. R. **113.** 1034.)

Zinc borate ammonia, $ZnB_4O_7, 4NH_3+6H_2O$.
Easily sol. in NH_4OH, $HC_2H_3O_2$, H_2SO_4, HCl, and HNO_3+Aq. (Büchner, A. **151.** 234.)

Zinc borate bromide, $6ZnO, 8B_2O_3, ZnBr_2$.
(Rousseau and Allaire, C. R. **116.** 1446.)

Zinc borate chloride, $6ZnO,8B_2O_3,ZnCl_2$.
Insol. in HCl. (Rousseau, C. R. 1894, **118.** 1256.)

Zinc borate iodide, $6ZnO, 8B_2O_3, ZnI_2$.
(Allaire, C. R. 1898, **127.** 556.)

Zirconium borate, (?).
Insol. in H_2O.

*Per*boric acid.
See **Perboric Acid.**

Boric phosphoric acid.
See **Phosphoboric acid.**

Boric tungstic acid.
See **Borotungstic acid.**

Boric acid sulphur *tri*oxide.
See **Borosulphuric acid.**

Borimide, $B_2(NH)_3$.
Decomp. by H_2O; insol. in all indifferent solvents; sol. in liquid NH_3+S to form a dark blue solution. (Stock, B. 1901, **34.** 3044.)

Borimide hydrochloride, $B_2(NH)_3$,3HCl.
Decomp. by H_2O; insol. in all ordinary organic solvents. (Stock, B. 1901, **34.** 3045.)

Borofluorhydric acid, HBF_4.
See **Fluoboric acid.**

Borofluorides.
See **Fluoborides.**

Boromolybdic acid.
Sol. in H_2O. Decomp. by alcohol. (Berzelius.)

Boron, B.
(*a*) *Amorphous.* Somewhat sol. in pure H_2O, when not ignited. Salts and acids separate it out of aqueous solution. Upon evaporation of H_2O solution a crust is formed, which is only partially sol. in H_2O. (Berzelius, Pogg. **2.** 113.) Decomp. by hot H_2SO_4 and cold moderately conc. HNO_3+Aq. Strongly ignited amorphous B is much less easily attacked by reagents than freshly pptd., and is insol. in H_2O. (Berzelius.) Insol. in caustic alkalies+Aq; also in alcohol and ether.
Above boron was very impure. (Moissan, C. R. **114.** 392.)
Pure B is not attacked by acids, but has a strong reducing action on $KMnO_4$+Aq, $FeCl_3$ +Aq, etc. (Moissan, C. R. **114.** 617.)
Does not melt at 1500°. Readily sol. in conc. acids, as H_2SO_4, HNO_3, H_3PO_4; very sl. sol. in hydracids; decomp. H_2O at red heat. (Moissan, A. ch. 1895, (7) **6.** 313–14.)
Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 827.)
(*b*) *Crystallized.* 1. Insol. in H_2O, HCl, or KOH+Aq. Very slightly and slowly attacked by boiling conc. H_2SO_4. Gradually sol. in hot conc. HNO_3. Formula is Al_2B_{24}. (Hampe, A. **183.** 75.)
2. Very slightly attacked by conc. HCl or H_2SO_4; slowly but completely sol. in conc. HNO_3; insol. in KOH+Aq. Formula is $C_2Al_3B_{48}$. (Hampe.)
$C_2Al_3B_{44}$. *Crystalline.* Insol. in a solution of CrO_3 in H_2SO_4. Insol. in hot conc. HCl and H_2SO_4. Sol. in hot conc. HNO_3. (Biltz, B. 1910, **43.** 303.)

Boron *tri*bromide, BBr_3.
Sol. in H_2O or alcohol with decomp. (Nicklès, C. R. **60.** 800.)

Boron phosphorus bromide, BBr_3, PBr_3.
Decomp. by H_2O.
Sol. in CS_2, and $CHCl_3$. Decomp. by alcohol, ether, etc. (Tarible, C. R. **116.** 1521.)
BBr_3, PBr_5. Sl. sol. in cold, easily in hot CS_2. (Tarible.)

Boron bromide ammonia, $BBr_3, 4NH_3$.
Decomp. by H_2O and alkalies. (Besson, C. R. **114.** 542.)

Boron bromide phosphine, BBr_3, PH_3.
Violently decomp. by H_2O. (Besson, C. R. **113.** 78.)

Boron bromide phosphorus *tri*chloride, $2BBr_3,PCl_3$.

Decomp. by H_2O. Sol. in BBr_3, PCl_3, CS_2, and $CHCl_3$. Insol. in petroleum ether. (Tarible, C. R. 1901, **132**. 84.)

Boron bromide phosphorus *penta*chloride, $2BBr_3,PCl_5$.

Sol. in BBr_3 and CS_2; decomp. by H_2O; insol. in light petroleum. (Tarible, C. R. 1901, **132**. 85.)

Boron bromide phosphorus *di*iodide, $2BBr_3$, P_2I_4.

Sol. in BBr_3, CS_2, $CHCl_3$; insol. in light petroleum; decomp. by H_2O. (Tarible, C. R. 1901, **132**. 205.)

Boron bromide phosphoryl chloride, BBr_3, $POCl_3$.

Very easily decomp. (Oddo and Tealdi, Gazz. ch. it. 1903, **33**. (2) 431.)

Boron bromoiodide, BBr_2I.

Decomp. violently by H_2O. (Besson, C. R. **112**. 100.)

$BBrI_2$. (Besson, C. R. **112**. 100.)

Boron bromosulphide, B_2S_3,BBr_3.

Decomp. by H_2O. (Stock, B. 1901, **34**. 3040.)

Boron carbide, B_6C.

Very stable; insol. in HF and in HNO_3; sol. in KOH at red heat. (Moissan, Bull. Soc. 1894, (3) **11**. 1101.)

Insol. in acids; sol. in fused alkali. (Moissan, C. R. 1894, **118**. 559.)

BC or B_2C_2. Insol. in all the usual solvents. (Müllhäuser, Z. anorg. **5**. 92.)

Boron *tri*chloride, BCl_3.

Rapidly absorbed by H_2O and alcohol with decomposition.

Boron nitrosyl chloride, BCl_3, NOCl.

Decomp. violently by H_2O. (Geuther, J. pr. (2) **8**. 854.)

Boron phosphoryl chloride, BCl_3, $POCl_3$.

Decomp. immediately by H_2O. (Gustavson, Zeit. Chem. **1870**. 521.)

Boron chloride ammonia, $2BCl_3$, $3NH_3$.

Decomp. by H_2O. (Berzelius, Pogg. **2**. 147.)

Boron chloride phosphine, BCl_3, PH_3.

Decomp. by H_2O. (Besson, C. R. **110**. 516.)

Boron chlorosulphide, B_2S_3,BCl_3.

Decomp. by H_2O. (Stock, B. 1901, **34**. 3040.)

Boron *tri*fluoride, BF_3.

H_2O absorbs 700 vols. BF_3 gas to form a liquid of 1.77 sp. gr. On boiling, 1/5 of the BF_3 is given off, and a residue boiling at 165–200°, with composition BF_3+2H_2O or HBO_2+3HF, is left. (J. Davy, A. ch. **86**. 178.)

1 ccm. H_2O absorbs at 0° and 762 mm. pressure 1.057 ccm. BF_3.

1 vol. conc. H_2SO_4 of 1.85 sp. gr. absorbs 50 vols. BF_3.

Absorbed by alcohol with decomp.

Cold oil of turpentine absorbs 6.8% of BF_3.

Boron fluoride ammonia, BF_3,NH_3, BF_3, $2NH_3$, and BF_3, $3NH_3$.

Decomp. by H_2O.

Boron fluoride cyanhydric acid, BF_3, HCN.

Very unstable. (Patein, C. R. **113**. 85.)

Boron fluoride phosphine, $2BF_3$, PH_3.

Very unstable at ordinary temp. Decomp. by H_2O. (Besson, C. R. **110**. 80.)

Boron hydride, BH_3.

Not obtained free from H. Sl. sol. in H_2O. (Jones, Chem. Soc. **35**. 41.)

See **Cyclo*tri*borene.**

B_4H_{10}. B.-pt. 16–17° at 760 mm.

Very unstable. Takes fire spontaneously in the air.

Decomp. by H_2O, dil. HCl, and oxidized by conc. HNO_3 with explosive violence.

Absorbed by NaOH+Aq.

Decomp. by alcohol. Sol. in dry benzene. (Stock, B. 1912, **45**. 3562.)

B_6H_{12}. B.-pt. 100° at atmospheric pressure. Decomp. by H_2O. With aqueous alkalies, hydrogen is evolved. (Stock, B. 1912, **45**. 3565.)

B_8H. Insol. in HCl. Sol. in aqua regia and Br_2+Aq. (Winkler, B. 1890, **23**. 778.)

$B_{10}H_{14}$. M.-pt. 99.5°; not attacked by cold or boiling H_2O. Sol. in dil. NaOH+Aq. Sol. in alcohol, ether, benzene, and CS_2. (Stock, B. 1913, **46**. 3360.)

Boron iodide, BI_3.

Very hygroscopic, and instantly decomp, by H_2O or alcohol. Very sol. in CS_2, CCl_4. C_6H_6; less sol. in PCl_3, $AsCl_3$, and a great many organic liquids. (Moissan, C. R. **112**. 717.)

Boron iodide ammonia, BI_3, $5NH_3$.

Decomp. by H_2O. (Besson, C. R. **114**. 542.)

Boron iodophosphide, BI_2P.

Very hygroscopic; decomp. by H_2O. Not attacked by cold conc. H_2SO_4, even if fuming, but on heating decomposition takes place. Very sl. sol. in CS_2. Insol. in benzene, PCl_3, or CCl_4. (Moissan, C. R. **113**. 624.)

BIP. Less hygroscopic than BI_2P, but otherwise the properties are similar. (Moissan.)

Boron nitride, BN.

Insol. in H_2O, conc. HNO_3, conc. HCl+Aq, or conc. solutions of alkalies.

Decomp. by hot conc. H_2SO_4 or HF. (Wöhler, A. **74.** 70.)

Boron *tri*oxide, B_2O_3.

Deliquescent. Sol. in H_2O with a large increase in temp. (Ditte, C. R. **85.** 1069.)

1 pt. dissolves—

at	18.75°	in 47.01	pts. H_2O.
"	25°	" 27.75	" "
"	37.5°	" 18.73	" "
"	50°	" 15.13	" "
"	62.5°	" 9.29	" "
"	75°	" 7.28	" "
"	87.5°	" 5.58	" "
"	100°	" 4.74	" "

Or 100 pts. H_2O dissolve—

at	18.75°	2.13	pts. B_2O_3.
"	25°	3.60	" "
"	37.5°	4.24	" "
"	50°	6.61	" "
"	62.5°	10.76	" "
"	75°	13.73	" "
"	87.5°	17.92	" "
"	100°	21.09	" "

(Brandes and Firnhaber, Arch. Pharm. **7.** 50.)

1 litre H_2O dissolves—

at	0°	11.00	g. B_2O_3.
"	12°	16.50	" "
"	20°	22.49	" "
"	40°	39.50	" "
"	62°	64.50	" "
"	80°	95.00	" "
"	102°	164.50	" "

(Ditte, C. R. **85.** 1069.)

Sat. H_2O solution boils at 100°. (Brandes and Firnhaber.)

Sat. H_2O solution boils at 103.3°. (Griffiths, Quar. J. Sci. **18.** 90.)

Sol. in acetic acid, hot conc. HCl+Aq, HNO_3, and H_2SO_4. From the three latter it separates on cooling or dilution with H_2O.

Solubility in Na_2O+Aq at 30.

See **Borates, sodium.**

Solubility in K_2O+Aq at 30°.

See **Borates, potassium.**

Insol. in hot glacial acetic acid. (Holt, Chem. Soc. 1911, **100.** (2) 720.)

Insol. in alcohol. (Graham.)

Sol. in alcohol. (Berzelius, Ebelmen.)

Sol. in oils.

See also **Boric acid.**

Boron *tri*oxide potassium fluoride, B_2O_3, 2KF.

Gradually sol. in H_2O. Decomp. by much H_2O. Insol. in alcohol. (Schiff and Sestini, A. **228.** 82.)

Boron oxychloride, BOCl.

(Gustavson, Zeit. Chem. **1870.** 521.)

$BOCl_3$. Slowly decomp. by H_2O. (Councler, J. pr. (2) **18.** 399.)

Oxychlorides of either the above formulæ do not exist; the true formula for boron oxychloride is $B_8O_{11}Cl_2$. (Lorenz, A. **247.** 226.)

Boron phosphide, BP.

Insol. in H_2O. Sol. in conc. boiling alkalies +Aq with decomp. Decomp. by HNO_3+Aq. (Besson, C. R. **113.** 78.)

Insol. in PCl_3, $AsCl_3$, $SbCl_3$, CCl_4, and in fact in all known solvents.

Not attacked by boiling H_2O, conc. HCl, or HI+Aq. Sol. in conc. HNO_3 with decomp. on heating. Not attacked by cold H_2SO_4. (Moissan, C. R. **113.** 726.)

B_5P_3. Not attacked by boiling conc. HNO_3 +Aq. Insol. in all solvents. (Moissan.)

Boron phosphoiodide.

See **Boron iodophosphide.**

Boron selenide, B_2Se_3.

Violently decomp. by H_2O. (Sabatier, C. R. **112.** 1000.)

Boron *tri*sulphide, B_2S_3.

Decomp. with violence with H_2O. Combines with alcohol and ether. (Fremy, A. ch. (3) **38.** 312.)

Insol. in most solvents, but sl. sol. in PCl_3 without decomp.; more sol. in SCl_2, but does not crystallize from the solution. (Moissan, C. R. **115.** 203.)

Boron *tri*sulphide ammonia, $B_2S_3,6NH_3$.

Ppt. (Stock, B. 1901, **34.** 3042.)

Boron *penta*sulphide, B_2S_5.

Decomp. by H_2O and alcohol. (Moissan, C. R. **115.** 271.)

Borosulphuric acid, $BOHSO_4+SO_3$.

Decomp. by H_2O. (Schultz-Sellac, B. **4.** 12.)

$B(HSO_4)_3$. Very deliquescent. Easily sol. in fuming H_2SO_4. (D'Arcy, Chem. Soc. **55.** 155.)

$SO_2(O.BO)_2$. Hydroscopic. Deliquescent. Sol. in H_2O with decomp. Decomp. by cold alcohols. (Pictet, Bull. Soc. 1908, (4) **3.** 1121.)

$(SO_3)_2B_2O_3$. Hydroscopic. Deliquescent. Sol. in H_2O with decomp. Decomp. by cold alcohols. (Pictet, Bull. Soc. 1908, (4) **3.** 1121.)

Boro*nono*tungstic acid, $H_4B_2W_9O_{32}+22H_2O = 9WO_3, B_2O_3, 2H_2O+22H_2O$.

Sol. in less than 1/9 pt. H_2O, and as easily sol. in alcohol and ether. Sp. gr. of aqueous solution is somewhat under 3. (Klein, A. ch. (5) **28.** 370.)

Aluminum boro*nono*tungstate, $Al_4(B_2W_9O_{32})_3+65H_2O$.

Extremely sol. in H_2O. (Klein.)

Ammonium ——, $(NH_4)_4B_2W_9O_{32}+18H_2O$

Quickly effloresces. (Klein.)

Barium boro*nono*tungstate, $Ba_2B_2W_9O_{32}+19H_2O$.

Sol. in 4 pts. cold, and less than ½ pt. hot H_2O. (Klein.)

Cadmium ——, $Cd_2B_2W_9O_{32}+18H_2O$.

Deliquescent.

100 pts. of salt dissolve in less than 8 pts. H_2O at 19°. Sp. gr. of solution is 3.28. (Klein.)

Sp. gr. of sat. solution at 15.6°/4° = 3.2887; at 16.2°/4° = 3.2868. (Kahlbaum, Z. anorg. 1902, **29**. 229.)

Calcium ——, $Ca_2B_2W_9O_{32}+15H_2O$.

Sol. in $^1/_{10}$ pt. H_2O. Solution has sp. gr. = 3.10. (Klein.)

Cerium ——, $Ce_4(B_2W_9O_{32})_3+57H_2O$.

Very sol. in H_2O; sp. gr. of solution is over 3.

Chromium ——, $Cr_4(B_2W_9O_{32})_3+74H_2O$.

Very sol. in H_2O; sp. gr. of solution is 2.80. (Klein.)

Cobalt ——, $Co_2B_2W_9O_{32}+18H_2O$.

Very sol. in H_2O; sp. gr. of solution sat. at 19° = 3.36. (Klein.)

100 pts. H_2O dissolve 306.8 pts. anhydrous salt at 16.2°; 288 pts. at 18.5°; 299.7 pts. at 19.6°; 286 pts. at 21.8°.

Sp. gr. of solution sat. at 19.2°/4° = 3.1369. (Kahlbaum, Z. anorg. 1902, **29**. 218.)

Copper ——, $Cu_2B_2W_9O_{32}+19H_2O$.

25 pts. H_2O dissolve 100 pts. salt. Sp. gr. of solution = 2.6. (Klein.)

Lead ——, $Pb_2B_2W_9O_{32}+11H_2O$.

Sl. sol. in cold, easily sol. in hot H_2O. (Klein.)

Lithium ——, (?).

Very sol. in H_2O. Sp. gr. of solution is about 3.

Magnesium ——, $Mg_2B_2W_9O_{32}+22H_2O$.

Very sol. in H_2O. (Klein.)

Manganous ——, $Mn_2B_2W_9O_{32}+17H_2O$.

100 pts. dissolve in 13 pts. H_2O. Sp. gr. of solution at 19° = 3.15. (Klein.)

Mercurous ——, $3Hg_2O$, B_2O_3, $9WO_3+14H_2O$ (?).

Precipitate.

Insol. in H_2O. (Klein.)

Sol. in 20,000 pts. dil. cold, and 1000 pts. boiling HNO_3+Aq of 1.42 sp. gr.

Nickel ——, $Ni_2B_2W_9O_{32}+18H_2O$.

Very sol. in H_2O; sp. gr. of sat. solution at 19° = 3.32.

100 pts. H_2O dissolve 261.6 pts. at 21.2°.

Sp. gr. 15.75°/4° of solution = 2.2959. (Kahlbaum, Z. anorg. 1902, **29**. 218.)

Potassium boro*nono*tungstate, $K_4B_2W_9O_{32}+13H_2O$.

5 pts. salt dissolve in 8 pts. H_2O at 19° to form a solution of 1.38 sp. gr. The solution sat. at 100° has sp. gr. of over 2. (Klein.)

Silver ——, $Ag_4B_2W_9O_{32}+14H_2O$.

Very sl. sol. in H_2O.

Sodium ——, $Na_2H_2B_2W_9O_{32}+23H_2O$.

Very sol. in H_2O. Solution sat. at 19° contains 84 pts. salt to 16 pts. H_2O. (Klein.)

$Na_4B_2W_9O_{32}+12H_2O$. Sol. in less than $^1/_3$ pt. H_2O.

Thallium ——, $Tl_2B_2W_9O_{32}+5H_2O$.

Sl. sol. in hot H_2O and nearly insol. in cold H_2O. (Klein.)

Uranyl ——, $(UO_2)_3(B_2W_9O_{30})_2+30H_2O$.

Very sol. in H_2O. (Klein.)

Sp. gr. of solution = 3.1.

Zinc ——, $Zn_2B_2W_9O_{32}+2H_2O$.

Very sol. in H_2O. Sp. gr. of solution = 3.15. (Klein.)

Boro*deci*tungstic acid.

Barium boro*deci*tungstate, $Ba_2B_2W_{10}O_{35}+20H_2O$.

Sol. in H_2O. (Klein, C. R. **99**. 35.)

Boro*duodeci*tungstic acid, $H_8B_2W_{12}O_{43}$ = $4H_2O$, B_2O_3, 12 WO_3.

Known only in solution, which decomposes into boro*nono*tungstic acid and tungstic acid, when evaporated to a certain concentration. (Klein, C. R. **99**. 35.)

Barium potassium boro[illegible]tungstate. 3BaO, K_2O, B [illegible]

Potassium ——, $K_8B_2W_{12}O_{43}+21H_2O$.

Sol. in H_2O. (Klein.)

$2K_2O$, $12WO_3$, $B_2O_3+18H_2O$. Sol. in H_2O. (Klein.)

Boro*quatuordeci*tungstic acid, $H_{12}B_2W_{14}O_{51}$ = $6H_2O$, B_2O_3, $14WO_3$.

Has not been obtained in the free state. (Klein, A. ch. (5) **28**. 353.)

Barium boro*quatuordeci*tungstate, $Ba_3B_2W_{14}O_{48}$ = 3BaO, B_2O_3, $14WO_3+5H_2O$.

Sl. sol. in H_2O. (Klein.)

Barium sodium ——, 3½BaO, 1½Na_2O, $5H_2O$, B_2O_3, $14WO_3+29H_2O$.

Potassium ——, $3K_2O$, H_2O, B_2O_3, $14WO_3+22H_2O$.

Sol. in H_2O. (Klein.)

Silver ——, $Ag_8H_2B_2W_{14}O_{49}+7H_2O$.

Nearly insol. in cold H_2O. (Klein.)

Sodium ——, $Na_4H_8B_2W_{14}O_{51}+29H_2O$.

Sol. in H_2O (Klein.)

Sodium strontium boro*quatuordeci*tungstate, $3\frac{1}{2}SrO, 1\frac{1}{2}Na_2O, B_2O_3, 14WO_3+29H_2O$.
Decomp. by H_2O. (Klein.)

Boro*undeviginti*tungstic acid.

Barium boro*undeviginti*tungstate, $4BaO, B_2O_3, 19WO_3+30H_2O$.
Can be cryst. from H_2O. (Ebenhusen, Dissert. **1905.**)

Boro*quattuoretviginti*tungstic acid, $B_2O_3, 24WO_3+66H_2O$.
Deliquescent. Somewhat more sol. in H_2O than $B_2O_3, 28WO_3+62H_2O$. Also more stable. (Copaux, C. R. 1908, **147.** 975.)

Barium boro*quattuoretviginti*tungstate, $5BaO, B_2O_3, 24WO_3+54H_2O$.
100 pts. H_2O dissolve 50 pts. salt. (Copaux, A. ch. 1909, (8) **17.** 217.)
$6BaO, B_2O_3, 24WO_3+58H_2O$. (Copaux, *l. c.*)

Cadmium ——, $5CdO, B_2O_3, 24WO_3+51H_2O$.
Extremely sol. in H_2O. (Copaux, *l. c.*)

Calcium ——, $5CaO, B_2O_3, 24WO_3+44H_2O$.
Very sol. in H_2O. (Copaux, *l. c.*)

Lithium ——, $15Li_2O, B_2O_3, 24WO_3+38H_2O$. (Copaux, *l. c.*)

Magnesium ——, $5MgO, B_2O_3, 24WO_3+42H_2O$.
Very sol. in H_2O. (Copaux, *l. c.*)

Mercurous ——, $9Hg_2O, B_2O_3, 24WO_3+25H_2O$.
(Copaux, *l. c.*)

Potassium ——, $5K_2O, B_2O_3, 24WO_3+36H_2O$.
(Copaux, *l. c.*)

Sodium ——, $5Na_2O, B_2O_3, 24WO_3+5H_2O$.
As NH_4 salt. (Copaux, *l. c.*)

Boro*quinquetviginti*tungstic acid.

Potassium boro*quinquetviginti*tungstate, $5K_2O, B_2O_3, 25WO_3+34H_2O$. (Ebenhusen, Dissert. **1905.**)

Boro*duodetriginta*tungstic acid, $B_2O_3, 28WO_3+62H_2O$.
Decomp. in boiling aqueous solution. (Copaux, C. R. 1908, **147.** 975.)

Potassium boro*duodetriginta*tungstate, $6K_2O, B_2O_3, 28WO_3+42H_2O$.
Decomp. by boiling alkalies. (Copaux, A. ch. 1909 (8) **17.** 217.)

Borovanadic acid.
Sol. in H_2O. Easily decomp. (Guyard, Bull. Soc. (2) **25.** 354.)

***Meta*bromantimonic acid,** $HSbBr_6+3H_2O$.
Very hydroscopic. Loses Br_2 in the air. Decomp. by H_2O with separation of antimonic acid. (Weinland, B. 1903, **36.** 256.)

Ammonium *meta*bromantimonate, $NH_4SbBr_6+H_2O$.
Loses Br_2 in the air. Decomp. by H_2O. (Weinland, *l. c.*)

Iron (ferric) *meta*bromantimonate, $Fe(SbBr_6)_3+14H_2O$.
Very hydroscopic. Decomp. by H_2O. (Weinland, *l. c.*)

Lithium *meta*bromantimonate, $LiSbBr_6+4H_2O$.
Very hydroscopic. Loses Br_2 in the air. Decomp. by H_2O. (Weinland, *l. c.*)

Nickel *meta*bromantimonate, $Ni(SbBr_6)_2+12H_2O$.
Hydroscopic. Decomp. by H_2O. (Weinland, *l. c.*)

Potassium *meta*bromantimonate, $KSbBr_6+H_2O$.
Loses Br_2 in the air. Decomp. by H_2O. (Weinland, *l. c.*)

Bromarsenious acid.
See **Arsenyl bromide.**

Bromauric acid, $HAuBr_4+3H_2O$.
(Lengfeld, Am. Ch. J. 1901, **26.** 329.)
$+5H_2O$. Very sol. in H_2O. (Thomsen, J. pr. (2) **13.** 337.)
$+6H_2O$. Sol. in ether and $CHCl_3$ without decomp. (Lengfeld, Am. Ch. J. 1901, **26.** 329.)

Ammonium bromaurate, NH_4AuBr_4.
Ppt. (Gutbier, Z. anorg. 1914, **85.** 358.)

Barium bromaurate.
Not deliquescent. Sol. in H_2O. (v. Bonsdorff, Pogg. **17.** 261.)

Cæsium bromaurate, $CsAuBr_4$.
Sl. sol. in H_2O or alcohol. Insol. in ether. (Wells and Wheeler, Sill. Am. J. **144.** 157.)
Ppt. (Gutbier, Z. anorg. 1914, **85.** 360.)

Cerium bromaurate, $CeAuBr_6+8H_2O$.
Sol. in H_2O. (Jolin, Bull. Soc. (2) **21.** 533.)

Didymium bromaurate, $DiAuBr_6+9H_2O$.
Very deliquescent. Sol. in H_2O. (Cleve.)

Lanthanum bromaurate, $LaAuBr_6+9H_2O$.
Sol. in H_2O. (Cleve.)

Magnesium bromaurate.
Deliquescent in moist air. (v. Bonsdorff.)

Manganese bromaurate.
Deliquescent. (v. Bonsdorff.)

Potassium bromaurate, $KAuBr_4$.

Sl. sol. in H_2O. More sol. in cold alcohol than in H_2O. (v. Bonsdorff.)

$+2H_2O$. Sol. in 5.12 pts. H_2O at 15°, 1.56 pts. at 40°, and 0.48 pt. at 67°. Decomp. by ether. Sl. sol. in KBr+Aq. (Schottländer, A. **217.** 314.)

$+5H_2O$. Efflorescent. (v. Bonsdorff.)

Rubidium bromaurate, $RbAuBr_4$.

As cæsium bromaurate.

Ppt. (Gutbier, Z. anorg. 1914, **85.** 359.)

Samarium bromaurate, $SmAuBr_6+10H_2O$.

Very deliquescent. (Cleve, Bull. Soc. (2) **43.** 165.)

Sodium bromaurate, $NaAuBr_4$.

Slowly sol. in H_2O. (v. Bonsdorff.)

Zinc bromaurate, $Zn(AuBr_4)_2$.

Very deliquescent. (v. Bonsdorff.)

Bromauricyanhdric acid.

Not known in free state.

Barium bromauricyanide, $Ba[Au(CN)_2Br_2]_2+10H_2O$.

Very sol. in hot or cold H_2O, also in alcohol. (Lindbom, Lund. Univ. Arsk. **12.** No. 6.)

Cadmium bromauricyanide, $Cd[Au(CN)_2Br_2]_2+6H_2O$.

Very sol. in hot or cold H_2O, but solution is unstable. (Lindbom.)

Calcium bromauricyanide, $Ca[Au(CN)_2Br_2]_2+10H_2O$.

Extremely sol. in H_2O and alcohol. (Lindbom.)

Cobalt bromauricyanide, $Co[Au(CN)_2Br_2]_2+9H_2O$.

Moderately sol. in H_2O. Less sol. than other bromauricyanides. (Lindbom.)

Potassium bromauricyanide, $KAu(CN)_2Br_2+3H_2O$.

Sol. in H_2O and alcohol.

Sodium bromauricyanide, $NaAu(CN)_2Br_2+2H_2O$.

Very sol. in H_2O or alcohol.

Strontium bromauricyanide, $Sr[Au(CN)_2Br_2]_2+xH_2O$.

Very sol. in H_2O or alcohol.

Zinc bromauricyanide, $Zn[Au(CN)_2Br_2]_2+8H_2O$.

Easily sol. in cold or hot H_2O.

B[illegible], HBr.

[illegible]ted HBr+Aq has a sp. [illegible]s 82.02% HBr. (Cham[illegible] [illegible]. **70.** 620.) This, or a [illegible] leaves a residue, which distils unchanged at 125–125.5° under 785 mm. pressure, and contains 48.17% HBr (Topsoë); at 126° under 758 mm. pressure, and contains 46.83% HBr (Bineau); and has sp. gr. = 1.486 at 20° (Bineau); sp. gr. = 1.48 at 20° (Champion and Pellat); sp. gr. = 1.49 at 20° (Topsoë).

According to Roscoe (A. **116.** 214) an acid of constant composition, obtained by boiling a stronger or a weaker acid, if distilled under 752–762 mm. pressure, contains 47.38–47.86% HBr, and boils at 126° at 760 mm. pressure; but the composition is dependent on the pressure, as, for example, under 1952 mm. pressure, the residue boils at 153°, and contains 46.3% HBr. (Roscoe.)

By conducting dry air through HBr+Aq an acid is obtained containing 51.65% HBr if at 16°, and 49.35% HBr if at 100° (Roscoe).

1 vol. H_2O dissolves 600 ± vols. HBr at 10°. (Berthelot, C. R. **76.** 679.)

1 pt. H_2O at t° and 760 mm. pressure dissolves pts. HBr.

t°	Pts. HBr	t°	Pts. HBr	t°	Pts. HBr
—25	2.550	—5	2.280	+50	1.715
—20	2.473	0	2.212	+75	1.505
—15	2.390	+10	2.103	+100	1.300
—10	2.335	+25	1.930	...	...

(Roozeboom, R. t. c. **4.** 107.)

Absorption by 1 pt. H_2O at t° and p pressure in mm.

t° = —25°.

p	Pts. HBr	p	Pts. HBr
760	2.550	100	2.056
300	2.263	1	1.755
140	2.120	0.5	1.10

t° = —20°.

p	Pts. HBr	p	Pts. HBr
760	2.473	130	2.056
375	2.267	20	1.850
180	2.119	...	...

t° = —15°.

p	Pts. HBr	p	Pts. HBr
760	2.390	175	2.056
470	2.266	102	1.980
250	2.119	...	...

t° = —11.3°.

p	Pts. HBr	p	Pts. HBr
760	2.350	310	2.118
570	2.265	216	2.055

$t° = -5°$.

p	Pts. HBr	p	Pts HBr
760	2.280	430	2.117
730	2.264	298	2.055

$t° = 0°$.

p	Pts. HBr	p	Pts. HBr
760	2.212	380	2.054
540	2.116	5	1.085

(Roozeboom, R. t. c. **4.** 107.)

Sp. gr. of HBr+Aq.

Sp. gr.	% HBr	Temp.	Sp. gr.	% HBr	Temp.
1.055	7.67	14°	1.335	36.67	13°
1.075	10.19	14°	1.349	37.86	13°
1.089	11.94	14°	1.368	39.13	13°
1.097	12.96	14°	1.419	43.12	13°
1.118	15.37	14°	1.431	43.99	13°
1.131	16.92	14°	1.438	44.62	13°
1.164	20.65	14°	1.451	45.45	14°
1.200	24.35	13°	1.460	46.09	13°
1.232	27.62	13°	1.485	47.87	14°
1.253	29.68	13°	1.490	48.17	14°
1.302	33.84	13°	...	...	...

(Topsoë, B. **3.** 404.)

Sp. gr. of HBr+Aq at 14°.

% HBr	Sp. gr.	% HBr	Sp. gr.	% HBr	Sp. gr.
1	1.007	18	1.140	35	1.314
2	1.014	19	1.149	36	1.326
3	1.021	20	1.158	37	1.338
4	1.028	21	1.167	38	1.351
5	1.035	22	1.176	39	1.363
6	1.043	23	1.186	40	1.376
7	1.050	24	1.196	41	1.389
8	1.058	25	1.206	42	1.403
9	1.065	26	1.215	43	1.417
10	1.073	27	1.225	44	1.431
11	1.081	28	1.235	45	1.445
12	1.089	29	1.246	46	1.459
13	1.097	30	1.257	47	1.473
14	1.106	31	1.268	48	1.487
15	1.114	32	1.279	49	1.502
16	1.122	33	1.290	..	...
17	1.131	34	1.302	..	...

(Topsoë, calculated by Gerlach, Z. anal. **27.** 316.)

Sp. gr. of HBr+Aq at 15°.

% HBr	Sp. gr.	% HBr	Sp. gr.	% HBr	Sp. gr.
5	1.038	25	1.204	45	1.435
10	1.077	30	1.252	50	1.515
15	1.177	35	1.305	..	...
20	1.159	40	1.365	..	...

Only a "moderate degree of accuracy" is claimed for this table. (Wright, C. N. **23.** 242.)

Sp. gr. of HBr+Aq at 15°.

% HBr	Sp. gr.	% HBr	Sp. gr.	% HBr	Sp. gr.
1	1.0082	18	1.145	35	1.314
2	1.0155	19	1.154	36	1.326
3	1.0230	20	1.163	37	1.338
4	1.0305	21	1.172	38	1.350
5	1.038	22	1.181	39	1.362
6	1.046	23	1.190	40	1.375
7	1.053	24	1.200	41	1.388
8	1.061	25	1.209	42	1.401
9	1.069	26	1.219	43	1.415
10	1.077	27	1.229	44	1.429
11	1.085	28	1.239	45	1.444
12	1.093	29	1.249	46	1.459
13	1.102	30	1.260	47	1.474
14	1.110	31	1.270	48	1.490
15	1.119	32	1.281	49	1.496
16	1.127	33	1.292	50	1.513
17	1.136	34	1.303	..	...

(Biel, C. C. **1882.** 148.)

Absorbed by alcohol with formation of C_2H_5Br.

The composition of the hydrates formed by HBr at different dilutions is calculated from determinations of the lowering of the fr. pt. produced by HBr and of the conductivity and sp. gr. of HBr+Aq. (Jones, Am. Ch. J. 1905, **34.** 326.)

$+H_2O$. (Roozeboom, R. t. c. **5.** 363.)

$+2H_2O$. (Berthelot, A. ch. (5) **14.** 369.) (Pickering Chem. Soc.1894, **64** (2) 232. Mpt. —11.2°. (Pickering, *l. c.*)

$+3H_2O$. Mpt. —48.0°. (Pickering.)

$+4H_2O$. Mpt. —55.8°. (Pickering.)

$+5H_2O$. (Pickering.)

Bromhydric cyanhydric acid, 3HBr, 2HCN.

Decomp. by H_2O and alcohol.

Insol. in ether. (Gautier, A. ch. (4) **17.** 141.)

Bromic acid, $HBrO_3$.

Known only in aqueous solution.

Solution evaporated on water bath decomposes when it contains 4.26% $HBrO_3$. In vacuo, an acid containing 50.59% $HBrO_3$ corresponding to formula $HBrO_3+7H_2O$ can be obtained.

Not decomp. by dil. HNO_3, or H_2SO_4+Aq. Conc. H_2SO_4 decomposes.

Alcohol and ether are quickly oxidized by $HBrO_3$.

Bromates.

Most of the bromates are very sol. in H_2O, a few are sl. sol., but none are insol., the least sol. being $AgBrO_3$ and $Hg_2(BrO_3)_2$.

Aluminum bromate, $Al(BrO_3)_3$.

Deliquescent. (Rammelsberg, Pogg. **55.** 63.)

$+9H_2O$. Mpt. 62.3°. Less hygroscopic

than $Al(ClO_3)_2$. (Dobrosserdow, C. C. **1907.** I, 1723.)

Ammonium bromate, NH_4BrO_3.

Decomposes spontaneously; sol. in H_2O. (Rammelsberg, Pogg. **52.** 85.)

Barium bromate, $Ba(BrO_3)_2$.

Solubility of $Ba(BrO_3)_2$ in H_2O. 100 g. sat. $Ba(BrO_3)_2$+Aq at t° contain g. anhydrous $Ba(BrO_3)_2$.

t°	grams $Ba(BrO_3)_2$	t°	Grams $Ba(BrO_3)_2$
Eutectic point −0.034°±0.002°	0.280	50°	1.72
0°	0.286	60°	2.271
+10°	0.439	70°	2.922
20°	0.652	80°	3.521
25°	0.788	90°	4.26
30°	0.95	98.7°	5.256
40°	1.31	*99.65°	5.39

* 99.65° is bpt. at 740 mm.=100.39° at 760 mm.

(Anschütz, Z. phys. Ch. 1906, **56.** 240.)

100 g. sat. $Ba(BrO_3)_2$+Aq contain 0.793 g. $Ba(BrO_3)_2$ at 25°. Sp. gr. of the solution at 25°/4°=1.0038. (Harkins J. Am. Chem. Soc. 1911, **33.** 1815.)

Solubility of $Ba(BrO_3)_2$ in salts+Aq at 25°.
C=concentration of salt in salt+Aq in milliequivalents per l.
d_1=Sp. gr. at 25°/4° of salt+Aq.
S=solubility of $Ba(BrO_3)_2$ in salt+Aq expressed in milliequivalents per l.
d_2=sp. gr. at 25°/4° of $Ba(BrO_3)_2$+salt+Aq.

Salt	C	d_1	S	d_2
None			40.18	1.0038
KNO_3	25.018	0.9985	43.86	1.0059
	50.032	1.0030	47.03	1.0081
	99.970	1.0033	52.13	1.0120
$Ba(NO_3)_2$	25.018	1.0003	36.77	1.0059
	50.039	1.0025	34.74	1.0083
	99.97	1.0073	32.63	1.0132
	199.95	1.0183	30.95	1.0233
$KBrO_3$	24.988	1.0001	26.53	1.0046
	49.971	1.0031	17.37	1.0062
	99.85	1.0093	8.76	1.0109
$Mg(NO_3)_2$	100.0		52.57	1.0114

(Harkins, J. Am. Chem. Soc. 1911, **33.** 1815.)

+H_2O. Sol. in 130 pts. cold, and 24 pts. boiling H_2O. (Rammelsberg, Pogg. **52.** 81.)
Decomp. by H_2SO_4, or HCl+Aq.
Insol. in acetone. (Eidmann, C. C. **1899,** II. 1014; Naumann, B. 1904, **37.** 4329.)
Insol. in methyl acetate. (Naumann, B. 1909, **42,** 3790.)

Bismuth bromate.

Known only in solution, which decomp. on evaporation. (Rammelsberg, Pogg. **55.** 76.)

Cadmium bromate, $Cd(BrO_3)_2+H_2O$.

Sol. in 0.8 pt. cold H_2O. (Rammelsberg, Pogg. **55.** 74.)
+$2H_2O$. (Topsoë, J. B. **1872,** 164.)

Cadmium bromate ammonia, $Cd(BrO_3)_2$, $3NH_3$.

Decomp. by H_2O. (Rammelsberg, Pogg. **55.** 74.)
$Cd(BrO_3)_2$, $4NH_3$. Ppt. (Ephraim, B. 1915, **48.** 51.)

Calcium bromate, $Ca(BrO_3)_2+H_2O$.

Sol. in 1.1 pts. cold H_2O. (Rammelsberg, Pogg. **52.** 98.)

Cerous bromate, $Ce(BrO_3)_3+9H_2O$.

Easily sol. in H_2O. (Rammelsberg, Pogg. **55.** 63.)
Mpt. 49°; very sol. in H_2O with decomp. (James, J. Am. Chem. Soc. 1909, **31.** 914.)

Cobaltous bromate, $Co(BrO_3)_2+6H_2O$.

Sol. in 2.2 pts. cold H_2O; sol. in NH_4OH+Aq. (Rammelsberg, Pogg. **55.** 71.)

Cupric bromate, basic, 6CuO, $Br_2O_5+10H_2O$.

Ppt. (Rammelsberg, Pogg. **55.** 78.)

Cupric bromate, $Cu(BrO_3)_2+6H_2O$.

Easily sol. in H_2O. (Rammelsberg, Pogg. **52.** 92.)

Cupric bromate ammonia, $Cu(BrO_3)_2$, $4NH_3$.

Completely sol. in a little H_2O, but decomp. by dilution.
Insol. in alcohol. (Rammelsberg, Pogg. **52.** 92.)

Didymium bromate, $Di(BrO_3)_3+9H_2O$.

Sol. in H_2O. (Marignac.)

Dysprosium bromate, $Dy(BrO_3)_3+9H_2O$.

Mpt. 78°. Easily sol. in H_2O. Difficultly sol. in alcohol. (Jantsch, B. 1911, **44.** 1275.)

Erbium bromate, $Er(BrO_3)_3+9H_2O$.

Very sol. in alcohol and H_2O.

Glucinum bromate.

Deliquescent.

Iron (ferrous) bromate, $Fe(BrO_3)_2$.

Sol. in H_2O, but solution decomp. very easily.

Iron (ferric) bromate, $5Fe_2O_3$, $Br_2O_5+30H_2O$.

Partially sol. in H_2O, with separation of a more basic salt. Sol. in HBO_3+Aq. (Rammelsberg, Pogg. **55.** 68.)

Lanthanum bromate, $La(BrO_3)_3+9H_2O$.

Sol. in 3½ pts. H_2O at 15°. (Marignac, Ann. Min. (5) **15.** 274.)
Mpt. 37.5° in its water of crystallization. 416 pts. are sol. in 100 pts. H_2O at 25°. (James, J. Am. Chem. Soc. 1909, **31.** 913.)

Lead bromate, basic, $3PbO$, $Pb(BrO_3)_2+2H_2O$.

Ppt. (Strömholm, Z. anorg. 1904, **38.** 441.)

Lead bromate, $Pb(BrO_3)_2$.

Sl. sol. in H_2O. 13.37 x 10^{-1}g. are contained in 1 liter of sat. solution at 20°. (Böttger, Z. phys. Ch. 1903, **46.** 603.)

$+H_2O$. Sol. in 75 pts. cold H_2O. (Rammelsberg, Pogg. **52.** 96.)

Lithium bromate, $LiBrO_3$.

Very deliquescent, and sol. in H_2O. (Rammelsberg, Pogg. A. **55.** 63.)

Not deliquescent. (Politilitzin, B. **23.** 545 R.)

Sp. gr. of solution sat. at 18° = 1.833, and contains 60.4% $LiBrO_3$. (Mylius, B. 1897, **30.** 1718.)

$+H_2O$. Not deliquescent. (Potilitzin.)

Magnesium bromate, $Mg(BrO_3)_2+6H_2O$.

Efflorescent. Sol. in 1.4 pts. cold H_2O at 15°. Melts in its water of crystallization when heated. (Rammelsberg, Pogg. **52.** 89.)

Mercurous bromate, basic, $2Hg_2O$, Br_2O_5.

Insol. in warm H_2O. Sol. in HNO_3+Aq. (Rammelsberg, Pogg. **55.** 79.)

Mercurous bromate, $Hg_2(BrO_3)_2$.

Decomp. by H_2O into basic salt. Difficultly sol. in HNO_3+Aq; easily sol. in HCl+Aq. (Rammelsberg.)

Mercuric bromate, basic, $2HgO$, $Br_2O_5+H_2O$.

Slowly decomp. by cold, quickly by hot H_2O into oxide and an acid salt.

Easily sol. in dil. acids. (Topsoë, W. A. B. 66, **2.** 2.)

Mercuric bromate, $HgBrO_3+2H_2O$.

Sol. in 650 pts. cold, and 64 pts. boiling H_2O. Sl. sol. in HNO_3+Aq. Easily sol. in HCl+Aq. (Rammelsberg, Pogg. **55.** 79.)

Mercuric bromate ammonia.

Sol. with decomp. in HCl+Aq. (Storer's Dict.)

Neodymium bromate, $Nd(BrO_3)_3+9H_2O$.

Mpt. 66.7°. 146 pts. are sol. in 100 pts. H_2O at 25°. (James, J. Am. Chem. Soc. 1909, **31.** 915.)

Nickel bromate, $Ni(BrO_3)_2+6H_2O$.

Sol. in 3.58 pts. cold H_2O. (Rammelsberg, Pogg. **55.** 69.)

Nickel bromate ammonia, $Ni(BrO_3)_2$, $2NH_3$.

Sol. in H_2O, with decomposition of the major portion. Insol. in alcohol. (Rammelsberg, *l. c.*)

$Ni(BrO_3)_2$, $6NH_3$. Ppt. (Ephraim, B. 1915, **48.** 50.)

Potassium bromate, $KBrO_3$.

100 pts. H_2O dissolve 6.58 pts. $KBrO_3$ at 15° (Rammelsberg). 100 pts. H_2O dissolve 5.83 pts. $KBrO_3$ at 17.1° (Pohl, W. A. B. **6.** 595); at 0°, 3.11 pts.; at 20°, 6.92 pts.; at 40°, 13.24 pts.; at 60°, 22.76 pts.; at 80°, 33.90 pts.; at 100° 49.75 pts. $KBrO_3$. Sat. solution boils at 104°. (Kremers, Pogg. **97.** 5.)

1 l. H_2O at 25° dissolves 0.4715 moles $KBrO_3$. (Geffcken, Z. phys. Ch. 1904, **49.** 296.)

1 l. H_2O dissolves 0.478 mol. $KBrO_3$ at 25°. (Rothmund, Z. phys. Ch. 1909, **69.** 539.)

Sp. gr. of $KBrO_3$+Aq at 19.5°.

% $KBrO_3$	1	2	3	4	5
Sp. gr.	1.009	1.016	1.024	1.031	1.039
% $KBrO_3$	6	7	8	9	10
Sp. gr.	1.046	1.054	1.062	1.070	1.079

(Gerlach, Z. anal. **8.** 290.)

Solubility of $KBrO_3$ in salts+Aq at 25°.

Salt	Moles of $KBrO_3$ sol. in 1 liter of				
	.5-N solution	N solution	2-N solution	3-N solution	4-N solution
$NaNO_3$	0.5745	0.6497	0.7680	0.9026	1.031
NaCl	0.5220	0.5616	0.6042	0.6244	0.640

(Geffcken, Z. phys. Ch. 1904, **49.** 296.)

Easily sol. in liquid HF. (Franklin, Z. anorg. 1905, **46.** 2.)

Sl. sol. in alcohol. (Rammelsberg.)

Insol. in absolute alcohol.

Solubility in organic compds.+Aq at 25°.

Solvent	Mol. $KBrO_3$ sol. in 1 litre
Water	0.478
0.5-N Methyl alcohol	0.444
" Ethyl alcohol	0.421
" Propyl alcohol	0.409
" Tert. amyl alcohol	0.383
" Acetone	0.425
" Ether	0.395
" Formaldehyde	0.397
" Glycol	0.448
" Glycerine	0.451
" Mannitol	0.451
" Glucose	0.463
" Sucrose	0.431
" Urea	0.477
" Dimethyl pyrone	0.478
" Ammonia	0.445
" Diethylamine	0.384
" Pyridine	0.415
" Piperidine	0.396
" Urethane	0.433
" Formamide	0.473
" Acetamide	0.445
" Glycocoll	0.501
" Acetic acid	0.456
" Phenol	0.426
" Methylal	0.405
" Methyl acetate	0.420

(Rothmund, Z. phys. Ch. 1909, **69.** 539.)

Insol. in acetone. (Eidmann, C. C. **1899**, II. 1014; Naumann, B. 1904, **37**. 4329.)
Insol. in ethyl acetate. (Naumann, B. 1910, **43**. 314.)
Insol. in methyl acetate. (Naumann, B. 1909, **42**. 3790.)

Praseodymium bromate, $Pr(BrO_3)_3+9H_2O$.

Mpt. 56.5°. 190 pts. are sol. in 100 pts. H_2O at 25°. (James, J. Am. Chem. Soc. 1909, **31**. 914.)

Samarium bromate, $Sm(BrO_3)_3+9H_2O$.

Mpt. 75°. 114 pts. are sol. in 100 pts. H_2O at 25°. Very sl. sol. in alcohol. (James, J. Am. Chem. Soc. 1909, **31**. 915.)

Scandium bromate.

(Crookes, Roy. Soc. Proc. 1908, **80**, A, 518.)

Silver bromate, $AgBrO_3$.

1 pt. H_2O dissolves 0.00810 pt. $AgBrO_3$ at 24.5°. (Noyes, Z. phys. Ch. **6**. 246.)
Sol. in 595.3 pts. H_2O at 25°.
Sol. in 320.4 pts. HNO_3+Aq (sp. gr. 1.21) at 25°.
Sol. in 2.2 pts. NH_4OH+Aq (sp. gr. 0.96) at 25°. (Longi, Gazz. ch. it. **13**. 87.)
1 l. H_2O dissolves 1.71 g. $AgBrO_3$ at 27°. (Whitby, Z. anorg. 1910, **67**. 108.)
Sl. sol. in H_2O. 1.59 x 10^{-4} g. are contained in 1 liter of sat. solution at 20°. (Böttger, Z. phys. Ch. 1903, **46**. 603.)
Insol. in HNO_3. (Löwig.) Easily sol. in NH_4OH+Aq.

Silver bromate ammonia, $AgBrO_3$, $2NH_3$.

Decomp. in air or by H_2O. (Rammelsberg, Pogg. **52**. 94.)

Sodium bromate, $NaBrO_3$.

Sol. in 2.7 pts. H_2O at 15°. (Rammelsberg.)

100 pts. H_2O dissolve at—

0°	20°	40°	60°	80°	100°	
27.54	34.48	50.25	62.5	75.75	90.9	pts. $NaBrO_3$.

(Kremers, Pogg. **94**. 271.)

Easily forms supersaturated solutions.
Sat. solution boils at 109°. (Kremers.)
$NaBrO_3$+Aq containing 10.10% $NaBrO_3$ has sp.gr. 20°/20° = 1.0818.
$NaBrO_3$+Aq containing 11.09% $NaBrO_3$ has sp. gr. 20°/20° = 1.0900.
(Le Blanc and Rohland, Z. phys. Ch. 1896 **19**. 278.)

Sp. gr. of $NaBrO_3$+Aq at 19.5°.

% $NaBrO_3$	5	10	15
Sp. gr.	1.041	1.083	1.129
% $NaBrO_3$	20	25	30
Sp. gr.	1.178	1.231	1.289

Pogg. **97**. 5, calculated by Gerlach, Z. anal. **8**. 290.)

. in liquid NH_3. (Franklin, **20**. 829.)

Insol. in methyl acetate. (Naumann, B. 1909, **42**. 3790.)
Insol. in ethyl acetate. (Naumann, B. 1910, **43**. 314.)

Sodium bromate bromide, $3NaBrO_3$, $2NaBr+3H_2O$.

Decomp. by H_2O or alcohol. (Fritzsche.)

Strontium bromate, $Sr(BrO_3)_2+H_2O$.

Sol. in 3 pts. H_2O (Rammelsberg, Pogg. **52**. 84); less sol. in H_2O than $SrBr_2+6H_2O$. (Löwig.)

Thallous bromate, $TlBrO_3$.

Sl. sol. in hot H_2O; easily sol. in HNO_3+Aq. (Oettinger.)
Easily sol. in H_2O and dil. acids. (Ditte, A. ch. (6) **21**. 145.)

Terbium bromate, $Tb(BrO_3)_3+9H_2O$.

Not deliquescent. (Potratz, C. N. 1905, **92**, 3.)

Thallous bromate, $TlBrO_3$.

1 l. H_2O at 39.75° dissolves 2.216 x 10^{-2} g. mol. (Noyes and Abbott, Z. phys. Ch. 1895, **16**. 130.)
Sl. sol. in H_2O. 3.46 x 10^{-1} gram are contained in 1 liter of sat. solution at 20°. (Böttger, Z. phys. Ch. 1903, **46**. 603.)

Thallic bromate, $Tl(BrO_3)_3+3H_2O$.

Very hydroscopic. Easily decomp. by H_2O. (Gewecke, Z. anorg. 1912, **75**. 275.)

Thulium bromate, $Tm_2(BrO_3)_6+18H_2O$.

Pptd. from sat. aqueous solution by 95% alcohol.
NH_4OH is the best precipitant. (James, J. Am. Chem. Soc. 1911, **33**. 1342.)

Tin (stannous) bromate (?).

Insol. in H_2O; sol. in HCl+Aq.

Uranyl bromate, $4UO_3$, $3Br_2O_5+16H_2O$.

Sol. in H_2O. (Rammelsberg.)

Yttrium bromate, $Y(BrO_3)_3+9H_2O$.

More easily sol. in H_2O than $Y(IO_3)_3$. Sl. sol. in alcohol. Insol. in ether. (Cleve.)
Mpt. 74°. 168 pts. are sol. in 100 pts. H_2O at 25°.
Sl. sol. in alcohol. (James, J. Am. Chem. Soc. 1909, **31**. 916.)

Zinc bromate, $Zn(BrO_3)_2+6H_2O$.

Sol. in 1 pt. cold H_2O. (Rammelsberg, Pogg. **52**. 90.)

Zinc bromate ammonia, $Zn(BrO_3)_2$, $2NH_3+3H_2O$.

Decomp. by H_2O and alcohol. Sol. in NH_4OH+Aq. (Rammelsberg, Pogg. **52**. 90.)
$Zn(BrO_3)_2$, $4NH_3$. Ppt. (Ephraim, B. 1915, **48**. 51.)

***Per*bromic acid.**

See **Perbromic acid.**

Bromides.

Most bromides are sol. in H_2O, many in alcohol, and some in ether.

AgBr and Hg_2Br_2 are insol. in H_2O or acids; $PbBr_2$ and TlBr are sl. sol. therein. Cu_2Br_2 is insol. in H_2O, sol. in acids.

See under each element.

Bromine, Br_2.

1 pt. Br dissolves at 15° in 33 pts. H_2O. (Löwig, Pogg. **14.** 485.)

1 pt. Br dissolves at 15° in 31 pts. H_2O. (Dancer, Chem. Soc. **15.** 477.)

Solubility of Br in 100 pts. H_2O at t°.

t°	Pts. Br.	t°	Pts. Br	t°	Pts. Br
5	3.600	15	3.226	25	3.167
10	3.327	20	3.208	30	3.126

(Dancer, *l. c.*)

A sat. aqueous solution of Br contains 4.05% Br at 0°; 3.80% Br at 3°; 3.33%Br at 10°. (Roozeboom, R. t. c. **3.** 29, 59, 73, 84.)

1 l. H_2O dissolves 34 g. Br at 25°. (Jakowkin, Z. phys. Ch. 1896, **20.** 25.)

1 pt. is sol. in 30 pts. H_2O. (Dietze, Chem. Soc. 1899, **76** (2) 150.)

100 pts. H_2O dissolve at:

0°	10.34°	19.96°	30.17°	40.03°	49.85°
4.167	3.740	3.578	3.437	3.446	3.522

pts. bromine.

Liquid bromine as such is insol. in H_2O; only the vapor dissolves. (Winkler, Ch. Z. 1899, **23.** 688.)

1 l. H_2O dissolves 33.95 g. Br_2 at 25°. (McLauchlan, Z. phys. Ch. 1903, **44.** 617.)

Solubility of bromine vapor in H_2O at t°.
a = coefficient of absorption.

t°	a	t°	a
0	60.5	42	8.6
2	54.1	44	7.9
4	48.3	46	7.4
6	43.3	48	6.9
8	38.9	50	6.5
10	35.1	52	6.1
12	31.5	54	5.8
14	28.4	56	5.4
16	25.7	58	5.1
18	23.4	60	4.9
20	21.3	62	4.6
22	19.4	64	4.4
24	17.7	66	4.2
26	16.3	68	4.0
28	15.0	70	3.8
30	13.8	72	3.6
32	12.7	74	3.4
34	11.7	76	3.3
36	10.9	78	3.1
38	10.1	80	3.0
40	9.4	..	...

(Winkler, Ch. Z. 1899, **23.** 688.)

Solubility of bromine vapor.
(Mean of many determinations)

Temp.	Pressure	Absorption coefficient
0.0	56–13mm.	60.53
9.94°	89–16	35.22
20.46	138–9	20.87
30.38	179–12	13.65
40.31	229–26	9.22
50.25	274–53	6.50
60.04	314–46	4.84
69.98	154–54	3.82
80.22	396–74	2.94

Solubility of liquid bromine.
(The mean of many determinations)

Temp.	0.°	10.34°	19.96°	30.17°	40.03°	49.85°
Pts. H_2O that dissolve 1 pt. Br_2	24.0	26.74	27.94	29.10	29.02	28.38

Much less Br_2 is sol. in ice cold H_2O in the presence of bromine hydrate.

Solubility in presence of bromine hydrate.
(The mean of many determinations)

Temp.	0°	5.12°
Pts. H_2O that dissolve 1 pt. Br_2	42.39	26.26

(Winkler, Ch. Z. 1899, **23.** 688–689.)

Solubility of Br_2 in H_2O at 25° = 0.21 mols. in 1 l. (Bray, J. Am. Chem. Soc. 1910, **32.** 398.)

Sp. gr. of Br_2+Aq containing pts. Br in 1000 pts. solution.

Pts. Br.	Sp. gr.	Pts. Br.	Sp. gr.
10.72	1.00901	18.74–19.06	1.01491
10.68	1.00931	19.52–20.09	1.01585
12.05	1.00995	20.89–21.55	1.01807
12.21	1.01223	31.02–31.69	1.02367

(Slessor, N. Edin. Phil. J. **7.** 287.)

Sp. gr. of Br_2+Aq at 32.5°.

% Br_2 by weight	Sp. gr.
0.7214	0.999814
1.1172	1.002520
1.6448	1.006100
1.9956	1.008870
2.5960	1.013200

(Joseph, Chem. Soc. 1915, **107.** 3.)

Sol. in conc. HCl, HBr, conc. solutions of bromides, and in liquid SO_2. (Sestini; Zeit. Chem. **1868.** 718.)

Much more sol. in HCl+Aq than in H_2O.

100 ccm. HCl+Aq of 1.153 sp. gr. dissolve 36.4 g. Br at 12°.

More sol. in $SrCl_2$, and $BaCl_2$+Aq than in H_2O. (Berthelot, C. R. **100.** 761.)

Bromine is not more sol. in KBr+Aq than in H_2O (?). (Balard.)

KBr+Aq containing 1 pt. KBr to 6 pts. H_2O takes up as much Br as it already contains; when this solution is heated the dissolved Br is separated. 1 pt. KBr+1 pt. H_2O takes up twice as much Br as it already contains, much heat being evolved. This solution loses Br on exposure to the air or when heated. (Löwig.)

Solubility of Br_2 in KBr+Aq.

g. Mols. KBr per l.	g. at. Br dissolved per l at 18.5°	g. at. Br dissolved per l. at 26.5°.
0.00	0.4448	0.4282
0.01	0.4634	0.4490
0.02	0.4823	0.4671
0.03	0.5049	0.4925
0.04	0.5243	0.5101
0.05	0.5431	0.5301
0.06	0.5668	0.5530
0.07	0 5895	0.5636
0.08	0.6059	0.5920
0.09	0.6301	0.5981
0.1	0.6533	0.6488
0.2	0.8718	0.8591
0.3	1.0549	1.0787
0.4	1.3124	1.2704
0.5	1.5436	1.4731
0.6	1.7712	1.6717
0.7	2.0006	1.9197
0.8	2.2354	2.1029
0.9	2.4851	2.3349

The above figures indicate that below a concentration of 0.1 g. mol. KBr per l. just enough Br is dissolved to form KBr_3, while above that concentration somewhat larger amounts of Br are dissolved, which is greater at the lower temp.

(Worley, Chem. Soc. 1905, **87.** 1109.)

Solubility of Br_2 in NaBr+Aq at 25°.

g. NaBr per l.	g.-atoms Br_2 per l.	Sp. gr.
92.6	2.479	1.213
160.5	4.345	1.372
205.8	6.195	1.515
255.8	8.575	1.678
319.7	13.65	1.997
359.0	16.04	2.137
....	19.23	2.327
408.3	20.85	2.420

(Bell, J. Am. Chem. Soc. 1912, **34.** 14.)

Solubility in salts+Aq.

Solubility in 1 liter K_2SO_4+Aq at 25°.

K_2SO_4+Aq	g. Bromine
1–N	25.14
1/2–N	29.44
1/4–N	31.46
1/8–N	32.70
1/16–N	33.10

(Jakowkin, Z. phys. Ch. **1896,** 20, 26.)

Solubility in 1 liter Na_2SO_4+Aq at 25°.

Na_2SO_4+Aq	g. Bromine
1–N	25.07
1/2–N	29.20
1/4–N	31.33
1/8–N	32.94
1/16–N	33.26

(Jakowkin, *l. c.*)

Solubility in 1 liter $NaNO_3$+Aq at 25°.

$NaNO_3$+Aq	g. Bromine
1–N	28.80
1/2–N	31.35
1/4–N	32.62
1/8–N	33.33
1/16–N	33.74

(Jakowkin, *l. c.*)

Solubility in salts+Aq at 25°.

Salt+Aq.	g. Br_2 sol. in 1 liter
1/2–N . Na_2SO_4	23.90
1/2–N . K_2SO_4	24.80
1/2–N . $(NH_4)_2SO_4$	77 7
N . $NaNO_3$	28.00
N . KNO_3	28.95
N . NH_4NO_3	55.15
N . NaCl	55.90
N . KCl	57.40
N . NH_4Cl	82.2

(McLauchlan, Z. phys. Ch. 1903, **44.** 617.)

Solubility in $HgBr_2$+Aq at 25°.

10 ccm. of the solution contain:—

Millimols. Br_2	Millimols. Hg
2.125	0.
2.204	0.0560
2.216	0.0793
2.226	0.1284
2.231	0.2120

(Herz and Paul, Z. anorg. 1914, **85.** 215.)

1 l. N.$NH_4C_2H_3O_2$+Aq dissolves 340.5 g. Br_2 at 25°. (McLauchlan, Z. phys. Ch. 1903, **44.** 617.)

Miscible in all proportions with liquid NO_2. (Frankland, Chem. Soc. 1901, **79.** 1361.)

More sol. in alcohol than in H_2O; miscible with ether, CS_2, $CHCl_3$. (Sestini, Zeit. Chem. **1868.** 718.)

Somewhat soluble in glycerine. (Pelouze.) Sol. in benzene (Mansfield); insol. in benzene (Moride, A. ch. (3) **39.** 452). Sol. in warm chloral, bromal, and iodal. (Löwig, Pogg. **14.** 485.) Sol. in SCl_2 (Solly), and SBr_2. Sol. in conc. $HC_2H_3O_2$+Aq. (Balard.) Sol. in aqueous solution of potassium, sodium, or calcium acetates. (Cahours.)

Solubility in CS_2.
100 g. of the sat. solution contain at:

—95°	—110.5°	—116°
45.4	39.0	36.9 g. Br_2.

(Arctowski, Z. anorg. 1896, **11.** 274.)

Cryst. from CS_2 at —90° in fine needles. (Arctowski, Z. anorg. 1895, **10.** 25.)

Sp. gr. of Br_2+CCl_4 at 32.5°.

% Br_2 by weight	Sp. gr.
1.5449	1.58014
1.6454	1.58060
1.7990	1.58168
2.6676	1.58812
3.5833	1.59526

(Joseph, Chem. Soc. 1915, **107.** 3.)

Sp. gr. of Br_2+nitrobenzene at 32.5°.

% Br_2 by weight	Sp. gr.
1.5643	1.20225
3.2323	1.21449
4.6462	1.22518
6.1826	1.23603

(Joseph, Chem. Soc. 1915, **107.** 3.)

Very sol. in benzonitrile. (Naumann, B. 1914, **47.** 1369.)
Sol. in acetone. (Eidmann, C. C. **1899,** II, 1014; Naumann, B. 1904, **37.** 4328.)

Partition of Br_2 between water and other solvents.
W = millimols Bromine in 10 ccm. of the aqueous layer.
G = millimols Bromine in 10 ccm. of the other layer.

Other solvent	G	W	G/W
CCl_4	1.949	0.0853	22.73
	7.008	0.3085	22.71
	12.171	0.5300	23.13
	39.880	1.3132	30.32
	54.574	1.5560	35.01
75% by vol. CCl_4 +25% by vol. CS_2	3.567	0.0985	37.06
	7.304	0.1910	38.15
	10.833	0.2900	37.36
	13.922	0.3720	37.42
	17.230	0.4580	37.62
	25.637	0.6580	38.96
	40.625	0.9940	40.88
	54.035	1.2080	44.73
50% by vol. CCl_4+ 50% by vol. CS_2	3.592	0.0784	45.82
	6.820	0.1487	46.85
	10.148	0.2206	46.01
	13.866	0.3065	45.24
	16.616	0.3688	45.05
	42.975	0.8086	53.15
	55.965	0.9960	56.19
25% by vol. CCl_4 +75% by vol. CS_2	5.753	0.0884	65.05
	10.902	0.1682	64.82
	26.724	0.4970	65.65
	41.314	0.6331	65.26
	55.526	0.8520	65.17

Partition of Br_2, etc.—*Continued*

Other solvent	G	W	G/W
CS_2	7.750	0.1015	76.35
	10.600	0.1387	76.44
	14.696	0.1910	76.98
	17.999	0.2352	76.54
	26.345	0.3467	75.99
	40.625	0.5194	78.21
	57.038	0.7160	79.66

(Herz, Z. Elektrochem, 1910, **16.** 871.)

Partition coefficient for bromine between CS_2 and H_2O at 25°C.
A = concentration of the water layer.
C = concentration of the CS_2 layer.

A	C	N = C/A
7.545	691.9	91.71
4.109.	338.6	82.41
2.660	217.4	81.72
2.544	207.7	81.66
1.740	140.38	80.67
1.2878	103.7	80.51
0.8073	64.44	79.83
0.5046	39.64	78.38

Partition coefficient for bromine between $CHBr_3$ and H_2O at 25°C.
A = concentration of the water layer.
C = concentration of the $CHBr_3$ layer.

A	C	N = C/A
5.424	373.6	68.88
3.838	264.7	68.80
2.368	161.5	68.19
1.348	90.17	66.90
0.766	50.49	65.84
0.366	23.62	64.85

Partition coefficient for bromine between CCl_4 and H_2O at 25°C.
A = concentration of the water layer.
C = concentration of the CCl_4 layer.

A	C	N = C/A
14.42	545.2	37.82
10.80	372.2	34.44
7.901	252.8	32.01
7.163	225.8	31.52
6.803	218.5	32.12
5.651	172.6	30.54
3.216	94.84	29.48
2.054	58.36	28.41
1.266	35.92	28.37
0.7711	21.53	27.92
0.5761	15.72	27.26
0.4476	12.09	27.02
0.3803	10.27	27.00
0.2478	6.691	27.00

(Jakowkin, Z. phys. Ch. 1895, **18.** 588.)

Partition of bromine between CCl_4 and salts+Aq.
A = concentration of Br in H_2O layer.
C = concentration of Br in CCl_4 layer.

Partition of Br_2 between CCl_4 and $NaNO_3$+Aq at 25°.

$NaNO_3$+Aq	A	C
1-N	7.905	316.7
1/2-N	8.763	319.5
1/4-N	9.033	315.7
1/8-N	9.200	316.7
1/16-N	9.399	319.3

(Jakowkin, Z. phys. Ch. **1896**, 20, 25.)

Partition of Br_2 between CCl_4 and K_2SO_4+Aq at 25°.

K_2SO_4+Aq	A	C
1-N	5.982	255.4
1/2-N	6.843	253.4
1/4-N	7.354	252.8
1/8-N	7.585	250.3
1/16-N	7.498	242.3

(Jakowkin, *l. c.*)

Partition of Br_2 between CCl_4 and Na_2SO_4+Aq at 25°.

Na_2SO_4+Aq	A	C
1-N	5.934	254.6
1/2-N	6.838	253.4
1/4-N	7.402	254.4
1/8-N	7.609	252.8
1/16-N	7.713	251.2

(Jakowkin, *l. c.*)

Crystallizes at 4° with $10H_2O$.

Bromine chloride, $BrCl$.

Sol. in H_2O, CS_2, ether, etc.

Bromine fluoride, BrF_3.

Fumes in the air. Decomp. by H_2O. (Lebeau, C. R. 1905, **141.** 1019.)

Bromine oxides.

No oxides of bromine are known in the free state. *See* hypobromous, bromic, *and* perbromic acids.

Bromiridic acid.

Ammonium bromiridate, $(NH_4)_2IrBr_6$.

Less sol. in cold H_2O than the K salt. (Birnbaum, Zeit. Chem. **1865.** 22.)
Very sol. in cold H_2O. (Gutbier, B. 1909, **42.** 3910.)

Cæsium bromiridate, Cs_2IrBr_6.

Sol. in H_2O. (Gutbier, B. 1909, **42.** 3911.)

Potassium bromiridate, K_2IrBr_6.

Moderately sol. in cold, more easily in hot H_2O.
Insol. in alcohol or ether.
Sol. in cold H_2O and in HBr+Aq. (Gutbier, B. 1909, **42.** 3910.)

Rubidium bromiridate, Rb_2IrBr_6.

Very sol. in cold H_2O. Sol. in hot dil. HBr+Aq. (Gutbier, B. 1909, **42.** 3911.)

Sodium bromiridate.

Deliquescent. Easily sol. in H_2O, alcohol, or ether.

Bromiridous acid, $H_6Ir_2Br_{12}+6H_2O$.

Easily sol. in H_2O, alcohol, or ether. (Birnbaum, **1864.**)

Ammonium bromiridite, $(NH_4)_6Ir_2Br_{12}+H_2O$.

Difficultly sol. in H_2O. (Birnbaum.)

Potassium bromiridite, $K_6Ir_2Br_{12}+6H_2O$.

Efflorescent. Sol. in H_2O.

Silver bromiridite, $Ag_6Ir_2Br_{12}$.

Ppt. Insol. in H_2O or acids.

Sodium bromiridite, $Na_6Ir_2Br_{12}+24H_2O$.

Efflorescent. Very sol. in H_2O.

Bromocarbonatoplatin*di*amine carbonate, $\frac{CO_3}{Br_2}[Pt(N_2H_6)_2]_2(CO_3)_2+4H_2O$.

Ppt.

Bromocarbonatoplatin*di*amine carbonate bromoplatin*di*amine nitrate,
$\frac{CO_3}{Br_2}[Pt(N_2H_6)_2]_2(CO_3)_2,\ 2Br_2Pt(N_2H_6)_2(NO_3)_2$.

Bromochloroplatin*di*amine chloride,
$\frac{Br}{Cl}Pt(N_2H_6)_2Cl_2$.

Very sl. sol. in H_2O. (Cleve.)

—— chlorobromide, $\frac{Br}{Cl}Pt\frac{N_2H_6Cl}{N_2H_6Br}$(?).

Very sl. sol. in H_2O.

Bromochlororoplatinic acid.

Potassium bromochloroplatinate, K_2PtCl_5Br.
(Pitkin, J. Am. Chem. Soc. **2.** 408.)
Mixture. (Herty, J. Am. Chem. Soc. 1896, **18.** 130.)
$K_2PtCl_4Br_2$. Sl. sol. in cold H_2O; much more sol. in hot H_2O. (Pitkin.)
Mixture. (Herty.)
$K_2PtCl_3Br_3$. As above.
$K_2PtCl_2Br_4$. (Pigeon, A. ch. 1894, (7) **2.** 488.)
$K_2PtClBr_5$. (Pitkin.)

Bromochromic acid.

Potassium bromochromate, $KCrO_3Br_2$ = $CrO_2(Br)OK$.

Decomp. by H_2O. (Heintze, J. pr. (2) **4.** 225.)

***Di*bromochromium chloride,** $[Cr(H_2O)_4Br_2]Cl+2H_2O$.

Ppt. Nearly insol. in fuming HCl. (Bjerrum, B. 1907, **40.** 2918.)

Bromohydroxyloplatin*di*amine bromide, $\begin{matrix}OH\\Br\end{matrix}Pt(N_2H_6Br)_2$.

Very sl. sol. in H_2O. (Cleve.)

—— **chloride,** $\begin{matrix}OH\\Br\end{matrix}Pt(N_2H_6Cl)_2$.

Sol. in H_2O (Cleve.)

—— **nitrate,** $\begin{matrix}OH\\Br\end{matrix}Pt(N_2H_6NO_3)_2$.

Very sl. sol. in cold, moderately sol. in hot H_2O. (Cleve.)

Bromohydroxyloplatin*monodi*amine nitrate, $\begin{matrix}Br\\OH\end{matrix}Pt\begin{matrix}(NH_3)_2NO_3\\NH_3NO_3\end{matrix}+H_2O$.

Easily sol. in H_2O. (Cleve.)

Bromomercurosulphurous acid.

Ammonium bromomercurosulphite, NH_4SO_3HgBr.

Sol. in H_2O. (Barth, Z. phys. Ch. **9.** 215.)

Potassium bromomercurosulphite, KSO_3HgBr.

As above. (B.)

Bromomolybdenum bromide, $Br_4Mo_3Br_2$ = **molybdenum *di*bromide,** $MoBr_2$.

Insol. in H_2O or acids, or even in boiling aqua regia. Easily sol. in dilute, decomp. by conc. alkalies+Aq. (Blomstrand, J. pr. **82.** 436.)

Bromomolybdenum chloride, $Br_4Mo_3Cl_2+3H_2O$.

Insol. in acids. (Blomstrand.)

Bromomolybdenum chromate, $Br_4Mo_3CrO_4+2H_2O$.

Insol. in dil. acids. Sol. in hot conc. HCl +Aq. Insol. in alkali chromates+Aq. (Atterberg.)

Bromomolybdenum fluoride, $Br_4Mo_3F_2+3H_2O$.

Insol. in H_2O. (Atterberg.)

Bromomolybdenum hydroxide, $Br_4Mo_3(OH)_2$.

Completely sol. in alkalies if not heated over 90°. (Atterberg.)

$+2H_2O$.

$+8H_2O$.

Bromomolybdenum iodide hydroxide, $2Br_4Mo_3I_2$, $Br_4Mo_3(OH)_2+8H_2O$.

Precipitate. (Blomstrand, J. pr. **77.** 92.)

Bromomolybdenum molybdate, $Br_4Mo_3MoO_4$

Precipitate. (Atterberg.)

Bromomolybdenum phosphate, $Br_4Mo_3H_4(PO_4)_2$.

Precipitate. Insol. in H_2O. (Atterberg.)

Bromomolybdenum sulphate, $Br_4Mo_3SO_4$-$3H_2O$.

Precipitate. Sl. sol. in boiling H_2SO (Atterberg.)

***Di*bromomolybdous acid,** $MoOBr_2(OH)+1\frac{1}{2}H_2O$.

Sol. in H_2O. Very hydroscopic. (Weinland, Z. anorg. 1905, **44.** 86.)

***Tetra*bromomolybdous acid,** $MoBr_4(OH)+2H_2O$.

Sol. in H_2O. Hydroscopic. (Weinland *l. c.*)

***Di*ammonium *penta*bromomolybdite,** $MoBr_5O(NH_4)_2$.

Hydroscopic. Sol. in H_2O. (Weinland *l. c.*)

***Di*cæsium *penta*bromomolybdite,** $MoBr_5OCs_2$.

Hydroscopic. Sol. in H_2O. (Weinland *l. c.*)

Calcium *tetra*bromomolybdite, $(MoBr_4O)_2Ca$ $+7H_2O$.

Hydroscopic. Sol. in H_2O. (Weinland, *l. c*

***Mono*lithium *tetra*bromomolybdite,** $MoBr_4(OLi)+4H_2O$.

Hydroscopic. Sol. in H_2O. (Weinland *l. c.*)

Magnesium *penta*bromomolybdite, $MoBr_5(OMg)+7H_2O$.

Hydroscopic. Sol. in H_2O. (Weinland *l. c.*)

***Mono*potassium *tetra*bromomolybdite,** $MoBr_4(OK)+2H_2O$.

Hydroscopic. Sol. in H_2O. (Weinland *l. c.*)

***Di*potassium *penta*bromomolybdite,** $MoBr_5OK_2$.

Hydroscopic. Sol. in H_2O. (Weinland *l. c.*)

***Di*rubidium *penta*bromomolybdite,** $MoBr_5ORb_2$.

Hydroscopic. Sol. in H_2O. (Weinland *l. c.*)

Bromonitratoplatin*di*amine nitrate, $\begin{matrix}Br\\NO_3\end{matrix}Pt\begin{matrix}N_2H_6NO_3\\N_2H_6NO_3\end{matrix}$.

Decomp. by H_2O. (Cleve.)

—— **sulphate,** $\begin{matrix}Br\\NO_3\end{matrix}Pt(N_2H_6)_2SO_4+H_2O$.

Sl. sol. in H_2O.

Bromonitritoplatin*semidi*amine nitrite, $NO_2Br_2Pt(NH_3)_2NO_2$.

Sl. sol. in H_2O. (Blomstrand.)

Bromonitrous acid.

Platinum silver bromonitrite, $PtAg_2Br_2(NO_2)_4$.

Ppt. (Miolati, Gazz. ch. it. 1900, **30.** 588.)

Bromopalladic acid.

Ammonium bromopalladate, $(NH_4)_2PdBr_6$.

Difficultly sol. in cold H_2O. Decomp. by hot H_2O and by hot conc. H_2SO_4. (Gutbier, B. 1905, **38.** 1907.)

Cæsium bromopalladate, Cs_2PdBr_6.

Difficultly sol. in cold H_2O. Decomp. by hot H_2O or by hot conc. H_2SO_4. (Gutbier, *l. c.*)

Potassium bromopalladate, K_2PdBr_6.

Difficultly sol. in cold H_2O. Decomp. by hot H_2O or by hot conc. H_2SO_4. (Gutbier, *l. c.*)

Rubidium bromopalladate, Rb_2PdBr_6.

Insol. in cold H_2O. Decomp. by hot H_2O or by hot conc. H_2SO_4. (Gutbier, *l. c.*)

Bromopalladious acid.

Ammonium bromopalladite, $(NH_4)_2PdBr_4$.

Very stable. Sol. in H_2O. (Smith, Z. anorg. 1894, **6.** 381.)

Very sol. in cold H_2O.

Can be cryst. from a very small amount of hot H_2O. (Gutbier, B. 1905, **38.** 2387.)

Barium bromopalladite.

Not deliquescent. Sol. in H_2O. (v. Bonsdorff.)

Cæsium bromopalladite, Cs_2PdBr_4.

Very sol. in H_2O. (Gutbier, B. 1905, **38.** 2388.)

Manganese bromopalladite, $MnPdBr_4$.

Sol. in H_2O and alcohol. (v. Bonsdorff.)

$+7H_2O$. Very sol. in H_2O. (Smith, Z. anorg. 1894, **6.** 382.)

Potassium bromopalladite, K_2PdBr_4.

Easily sol. in H_2O. (Joannis, C. R. **95.** 295.)

Very stable. Sol. in H_2O. (Smith, Z. anorg. 1894, **6.** 381.)

$+2H_2O$. Unstable in the air. (Smith, *l. c.*)

Rubidium bromopalladite, Rb_2PdBr_4.

Can be cryst. from a very small amount of hot H_2O. (Gutbier, B. 1905, **38.** 2388.)

Sodium bromopalladite, $Na_2PdBr_4+4\frac{1}{2}H_2O$.

Very deliquescent. Sol. in H_2O. (Smith, *l. c.*)

Strontium bromopalladite, $SrPdBr_4+6H_2O$.

Stable in the air. Very sol. in H_2O. (Smith, *l. c.*)

Zinc bromopalladite.

Sol. in H_2O. (v. Bonsdorff.)

Bromophosphatoplatin*di*amine phosphate, $BrPt(N_2H_6)_2+2H_2O$.

$$\underbrace{BrPt(N_2H_6)_2}_{PO_4}$$

Sl. sol. in H_2O. (Cleve.)

Bromophosphoric acid.

Thorium bromophosphate, $ThBr_4$, $3(3ThO_2, 2P_2O_5)$.

Insol. in most acids and in fused alkali carbonates. Decomp. by long boiling with conc. H_2SO_4. (Colani, C. R. 1909, **149.** 208.)

Bromoplatinamine bromide, $Br_2Pt(NH_3Br)_2$.

Sl. sol. in H_2O. (Cleve, Sv. V. A. H. **10,** 9. 31.)

—— **nitrite,** $Br_2Pt(NH_3NO_2)_2$.

Very sl. sol. in H_2O. (Cleve.)

Bromoplatin*di*amine bromide, $Br_2Pt(N_2H_6)_2Br_2$.

Only sl. sol. in hot H_2O. (Cleve.)

—— **chloride,** $Br_2Pt(N_2H_6)_2Cl_2$.

Very sl. sol. in H_2O. (Cleve.)

—— ***di*chromate,** $Br_2Pt(N_2H_6)_2Cr_2O_7$.

Sl. sol. in H_2O.

—— **nitrate,** $Br_2Pt(N_2H_6NO_3)_2$.

Sl. sol. in cold, rather easily sol. in hot H_2O. (Cleve.)

—— **phosphate,** $Br_2Pt[N_2H_6PO_2(OH)_2]_2+2H_2O$.

Rather easily sol. in hot H_2O. (Cleve.)

—— **sulphate,** $Br_2Pt(N_2H_6)_2SO_4$.

Very sl. sol. in H_2O.

Bromoplatin*monodi*amine nitrate,

$$Br_2Pt\begin{matrix}(NH_3)_2NO_3\\NH_3NO_3\end{matrix}+H_2O.$$

Easily sol. in H_2O.

—— **sulphate,** $Br_2Pt\begin{matrix}(NH_3)_2\\NH_3\end{matrix}SO_4+H_2O$.

Moderately sol. in H_2O. (Cleve.)

Bromoplatin*semidi*amine bromide, $Br_3Pt(NH_3)_2Br$.

Sl. sol. in cold H_2O. (Cleve.)

Bromo*di*platin*di*amine anhydronitrate,

$$Br_2Pt_2\begin{matrix}(N_2H_6)_2(NO_3)_2.\\(NH_3NH_2)_2\end{matrix}$$

Sol. in HNO_3+Aq.

Bromo*di*platin*di*amine chloride, $Br_2Pt_2(N_2H_6)_4Cl_4$.

Ppt. (Cleve.)

—— **nitrate,** $Br_2Pt_2(N_2H_6)_4(NO_3)_4+2H_2O$.

Moderately sol. in hot H_2O.

—— **sulphate,** $Br_2Pt_2(N_2H_6)_4(SO_4)_2+2H_2O$.

Ppt. (Cleve.)

Bromoplatinic acid, $H_2PtBr_6+9H_2O$.

Very deliquescent, and sol. in H_2O, alcohol, ether, chloroform, or acetic acid. (Topsoë, J. B. **1868.** 273.)

Ammonium bromoplatinate, $(NH_4)_2PtBr_6$.

Sol. in 200 pts. H_2O at 15°. (Topsoë.)

100 pts. $(NH_4)_2PtBr_6$+Aq sat. at 20° contain 0.59 pt. dry salt. (Halberstadt, B. **17.** 2965.)

Barium bromoplatinate, $BaPtBr_6+10H_2O$.

Sl. deliquescent. Very sol. in H_2O.

Cæsium bromoplatinate, Cs_2PtBr_6.

Sl. sol. in dil. HBr+Aq. (Obermaier, Dissert.)

Calcium bromoplatinate, $CaPtBr_6+12H_2O$.

Sl. deliquescent. Very sol. in H_2O.

Cobalt bromoplatinate, $CoPtBr_6+12H_2O$.

Deliquescent.

Copper bromoplatinate, $CuPtBr_6+8H_2O$.

Very deliquescent; sol. in H_2O.

Lead bromoplatinate, $PbPtBr_6$.

Easily sol. in H_2O, but decomp. by large amount.

Lead *tetra*bromoplatinate, $[PtBr_4(OH)_2]Pb$, PbOH.

Insol. in H_2O. (Miolati, C. C. **1900,** II. 810.)

Magnesium bromoplatinate, $MgPtBr_6+12H_2O$.

Not deliquescent.

Manganese bromoplatinate, $MnPtBr_6+6H_2O$.

Sol. in H_2O.

$+12H_2O$. Sol. in H_2O.

Mercuric *tetra*bromoplatinate, $[PtBr_4(OH)_2]Hg$

Insol. in H_2O. (Miolati, C. C. **1900,** II. 810.)

Nickel bromoplatinate, $NiPtBr_6+12H_2O$.

Deliquescent.

Potassium bromoplatinate, K_2PtBr_6.

Sl. sol. in H_2O. Insol. in alcohol. (v. Bonsdorff, Pogg. **19.** 344.)

Sol. in 10 pts. boiling H_2O. (Pitkin, C. N. **41.** 218.)

100 pts. K_2PtBr_6+Aq sat. at 20° contain 2.02 pts. dry salt. (Halberstadt, B. **17.** 2962.)

Praseodymium bromoplatinate, $PrBr_3,PtBr_3+10H_2O$.

Deliquescent; very sol. in H_2O; sol. in HBr. (Von Schéele, Z. anorg. 1898, **18.** 353.)

Rubidium bromoplatinate, Rb_2PtBr_6.

Sl. sol. in dil. HBr+Aq. (Obermaier. Dissert.)

Silver bromoplatinate, Ag_2PtBr_6.

Insol. in H_2O. (Miolati, C. C. **1900,** II. 810.)

Silver *tetra*bromoplatinate, $[PtBr_4(OH)_2]Ag_2$.

Ppt.; insol. in H_2O. (Miolati, *l. c.*)

Sodium bromoplatinate, $Na_2PtBr_6+6H_2O$.

Easily sol. in H_2O and alcohol.

Strontium bromoplatinate, $SrPtBr_6+10H_2O$.

Sl. deliquescent. Very sol. in H_2O.

Thallium *tetra*bromoplatinate, $[PtBr_4(OH)_2]Tl_2$.

Insol. in H_2O. (Miolati, C. C. **1900,** II. 810.)

Ytterbium bromoplatinate, $YbBr_3,3H_2PtBr_6+30H_2O$.

Ppt. (Cleve, Z. anorg. 1902, **32.** 138.)

Zinc bromoplatinate, $ZnPtBr_6+12H_2O$.

Sol. in H_2O.

Bromoplatinocyanhydric acid, $H_2Pt(CN)_4Br_2$.

See **Perbromoplatinocyanhydric acid.**

Potassium bromoplatinocyanide, $5K_2Pt(CN)_4$, $K_2Pt(CN)_4Br_2+18H_2O$.

Sol. in H_2O.

Bromoplatinous acid.

Potassium bromoplatinite, $K_2PtBr_4+2H_2O$.

Extremely sol. in H_2O. (Billmann and Andersen, B. 1903, **36.** 1566.)

Bromopurpureochromium bromide, $BrCr(NH_3)_5Br_2$.

Less sol. in H_2O than chloropurpureochromium chloride. (Jörgensen, J. pr. (2) **25.** 83.)

—— **bromoplatinate,** $BrCr(NH_3)_5PtBr_6$. (Jörgensen, *l. c.*)

—— **chloride,** $BrCr(NH_3)_5Cl_2$.

More sol. in H_2O than the bromide. (Jörgensen, *l. c.*)

Bromopurpureochromium chromate, $BrCr(NH_3)_5CrO_4$.

Precipitate. (Jörgensen, *l. c.*)

—— **nitrate,** $BrCr(NH_3)_5(NO_3)_2$.

More sol. than bromide and less than chloride. (Jörgensen, *l. c.*)

Bromopurpureocobaltic bromide, $CoBr(NH_3)_5Br_2$.

Sol. in 530 pts. H_2O at 16°. Insol. in alcohol, NH_4Br, KBr, or HBr+Aq. More sol. in hot H_2O containing a little HBr. (Jörgensen, J. pr. (2) **19.** 49.)

Bromopurpureocobaltic mercuric bromide, $CoBr(NH_3)_5Br_2$, $3HgBr_2$.

More sol. in H_2O than the corresponding $HgCl_2$ salt. (J.)

—— **bromoplatinate.**

Very sl. sol. in cold H_2O. (J.)

—— **chloride,** $CoBr(NH_3)_5Cl_2$.

Difficultly sol. in cold H_2O, but much more easily than the bromide. Insol. in dil. HCl+Aq, and in alcohol.

—— **mercuric chloride,** $CoBr(NH_3)_5Cl_2$, $3HgCl_2$.

Sl. sol. in H_2O.

—— **chloroplatinate.**

Nearly or quite insol. in H_2O. (J.)

—— **chromate,** $CoBr(NH_3)_5CrO_4$.

Nearly insol. in H_2O.

—— **dithionate,** $CoBr(NH_3)_5S_2O_6$.

Nearly insol. in H_2O.

—— **fluosilicate,** $CoBr(NH_3)_5SiF_6$.

Very sl. sol. in cold H_2O; insol. in alcohol.

—— **nitrate,** $CoBr(NH_3)_5(NO_3)_2$.

More sol. in H_2O than the bromide, but less than the chloride. Wholly insol. in dil. HNO_3+Aq or alcohol.

—— **oxalate,** $CoBr(NH_3)_5C_2O_4$.

Nearly insol. in H_2O.

—— **sulphate,** $CoBr(NH_3)_5SO_4$.

Can be crystallized from very dil. H_2SO_4+Aq. Insol. in alcohol.
+$6H_2O$. Efflorescent.

Bromopurpureorhodium bromide, $BrRh(NH_3)_5Br_2$.

Much less easily sol. in H_2O than the chlorochloride. Insol. in dil. HBr+Aq and alcohol. (Jörgensen, J. pr. (2) **27.** 433.)

—— **bromoplatinate,** $BrRh(NH_3)_5PtBr_6$.

Almost insol. in H_2O.

—— **fluosilicate,** $BrRh(NH_3)_5SiF_6$.

Sl. sol. in H_2O. Sol. in boiling NaOH+Aq as roseo salt.

Bromopurpureorhodium nitrate, $BrRh(NH_3)_5(NO_3)_2$.

Sl. sol. in H_2O, but much more sol. than the bromide.

Bromorhodous acid.

Ammonium bromorhodite, $(NH_4)_2RhBr_5$.

Sol. in H_2O. (Goloubkine, Chem. Soc. 1911, **100** (2) 45.)
Sol. in H_2O. (Gutbier, B. 1908, **41.** 215.)

Barium bromorhodite, $BaRhBr_5$.

Sol. in H_2O. (Goloubkine, *l. c.*)

Cæsium bromorhodite, Cs_2RhBr_5.

Difficultly sol. in H_2O. (Gutbier, *l. c.*)

Potassium bromorhodite, K_2RhBr_5.

Very sol. in H_2O. (Goloubkine, *l. c.*)
Sol. in H_2O. (Gutbier, *l. c.*)

Rubidium bromorhodite, Rb_2RhBr_5.

Sol. in H_2O. (Goloubkine, *l. c.*)
Difficultly sol. in H_2O. (Gutbier, *l. c.*)

Sodium bromorhodite, Na_2RhBr_5.

Very sol. in H_2O. (Goloubkine, *l. c.*)

Bromoruthenic acid.

Potassium bromoruthenate, K_2RuBr_6.

Very sol. in H_2O. (Howe, J. Am. Chem. Soc. 1904, **26.** 946.)

Potassium *aquo*bromoruthenate, $K_2Ru(H_2O)Br_5$.

Ppt. (Howe, *l. c.*)

Rubidium bromoruthenate, Rb_2RuBr_6.

Sol. in H_2O. (Howe, *l. c.*)

Rubidium *aquo*bromoruthenate, $Rb_2Ru(H_2O)Br_5$.

Ppt. (Howe, *l. c.*)

Bromoruthenious acid.

Cæsium bromoruthenite, $CsRuBr_5+H_2O$.

Ppt. (Howe, J. Am. Chem. Soc. 1904, **26.** 945.)

Potassium bromoruthenite, K_2RuBr_5.

Very sol. in H_2O with decomp. Very sol. in dil. HBr. (Howe, *l. c.*)

Rubidium bromoruthenite, $Rb_2RuBr_5+H_2O$.

Sol. in dil. HBr. (Howe, *l. c.*)

Bromoselenic acid.

Ammonium bromoselenate, $(NH_4)_2SeBr_6$.

Sol. in H_2O with decomp. (Muthmann and Schäfer, B. **26.** 1008.)

Cæsium bromoselenate, Cs_2SeBr_6.

Sl. sol. in H_2O. (Lenher, J. Am. Chem. Soc. 1898, **20.** 571.)

Potassium bromoselenate, K_2SeBr_6.

As NH_4 salt. (M. and S.)

Rubidium bromoselenate, Rb_2SeBr_6.
Less sol. in H_2O than K salt. (Lenher, *l. c.*)

Bromo*pyro*selenious acid.

Ammonium bromo*pyro*selenite, $NH_4Br, 2SeO_2+2H_2O$.
More easily sol. in H_2O than corresponding Cl compound. (Muthmann and Schäfer, B. 1893, **26.** 1014.)

Potassium bromo*pyro*selenite, $KBr, 2SeO_2+2H_2O$.
Sol. in H_2O. (Muthmann and Schäfer, B. **26.** 1008.)

Bromosmic acid.

Ammonium bromosmate, $(NH_4)_2OsBr_6$.
Only sl. sol. in H_2O. (Rosenheim, Z. anorg. 1899, **21.** 135.)

Cæsium bromosmate, Cs_2OsBr_6.
Nearly insol. in H_2O and dil. HBr. (Gutbier, B. 1913, **46.** 2103.)

Potassium bromosmate, K_2OsBr_6.
Only sl. sol. in H_2O. (Rosenheim, *l. c.*)

Rubidium bromosmate, Rb_2OsBr_6.
Difficultly sol. in H_2O and in dil. HBr. (Gutbier, *l. c.*)

Silver bromosmate, Ag_2OsBr_6.
Ppt., insol. in H_2O. (Rosenheim, *l. c.*)

Sodium bromosmate, $Na_2OsBr_6+4H_2O$.
Sol. in H_2O. (Rosenheim, *l. c.*)

Bromostannic acid, $H_2SnBr_6+8H_2O$.

Very deliquescent. Sol. in H_2O. (Seubert, B. **20.** 794.)

Ammonium bromostannate, $(NH_4)_2SnBr_6$.
Very deliquescent, and sol. in H_2O. (Raymann and Preis, A. **223.** 323.)

Cæsium bromostannate.
Sol. in H_2O. (Raymann and Preis.)

Calcium bromostannate, $CaSnBr_6+6H_2O$.
Very deliquescent. Sol. in H_2O. (Raymann and Preis.)

Cobalt bromostannate, $CoSnBr_6+10H_2O$.
Deliquescent. (Raymann and Preis.)

Ferrous bromostannate, $FeSnBr_6+6H_2O$.
Deliquescent. (Raymann and Preis.)

Lithium bromostannate, $Li_2SnBr_6+6H_2O$.
Extremely deliquescent. (Leteur, C. R. **113.** 541.)

Magnesium bromostannate, $MgSnBr_6+10H_2O$.
Deliquescent. (Raymann and Preis.)

Manganous bromostannate, $MnSnBr_6+6H_2O$.
Deliquescent. (Raymann and Preis.)

Nickel bromostannate, $NiSnBr_6+8H_2O$.
Deliquescent. (Raymann and Preis.)

Potassium bromostannate, K_2SnBr_6.
Sol. in H_2O. (Topsoë.)

Rubidium bromostannate.
Sol. in H_2O. (Raymann and Preis.)

Sodium bromostannate, $Na_2SnBr_6+6H_2O$.
Not deliquescent, but extremely sol. in H_2O. (Seubert, B. **20.** 796.)

Strontium bromostannate, $SrSnBr_6+6H_2O$.
Very hydroscopic, and sol. in H_2O. (Raymann and Preis.)

Bromosulphatoplatin*di*amine sulphate,

$$\begin{array}{l}Br > Pt(N_2H_6)_2SO_4 \\ SO_4 \\ Br > Pt(N_2H_6)_2SO_4\end{array} + H_2O.$$

Rather easily sol. in hot H_2O.

Bromosulphobismuthous acid.

Cuprous bromosulphobismuthite, $2Cu_2S, Bi_2S_3, 2BiSBr$.
Stable in the air and insol. in H_2O at ord. temp. Partially decomp. by boiling H_2O. Decomp. by mineral acids with the evolution of H_2S. (Ducatte, C. R. 1902, **134.** 1212.)

Lead bromosulphobismuthite, $PbS, Bi_2S_3, 2BiSBr$.
Insol. in H_2O. Decomp. by boiling H_2O. Decomp. by dil. mineral acids with evolution of H_2S. (Ducatte, *l. c.*)

Bromotantalum bromide, $(Ta_6Br_{12})Br_2+7H_2O$.

Stable in the air when in the solid state. Sol. in H_2O without decomp. Sol. in propyl alcohol. (Chapin, J. Am. Chem. Soc. 1910, **32.** 328.)

Bromotantalum chloride, $(Ta_6Br_{12})Cl_2+7H_2O$.
(Chapin, *l. c.*)

Bromotantalum hydroxide, $(Ta_6Br_{12})(OH)_2+10H_2O$.
Sl. sol. in HCl. Stable in the air below 100°.
Sol. in alcohol. Insol. in ether. (Chapin, *l. c.*)

Bromotantalum iodide, $(Ta_6Br_{12})I_2+7H_2O$.
(Chapin, *l. c.*)

Bromotelluric acid.

Ammonium bromotellurate, $(NH_4)_2TeBr_6$.
Less sol. in H_2O than K salt. (Muthmann and Schmidt, B. 1893, **26.** 1011.)

Cæsium bromotellurate, Cs_2TeBr_6.

Decomp. by H_2O.

100 pts. $HBr+Aq$ (sp. gr. 1.49) dissolve 0.02 pt. at 22°.

100 pts. $HBr+Aq$ (sp. gr. 1.08) dissolve 0.13 pt. at 22°.

Insol. in alcohol. (Wheeler, Sill. Am. J. **145.** 267.)

Potassium bromotellurate, $K_2TeBr_6+3H_2O$.

Sol. in little, decomp. by much H_2O. (v. Hauer.)

Contains $2H_2O$. (Wheeler, Sill. Am. J. **145.** 267.)

Efflorescent.

100 pts. $HBr+Aq$ (sp. gr. 1.49) dissolve 6.57 pts. at 22°.

100 pts. $HBr+Aq$ (sp. gr. 1.08) dissolve 62.90 pts. at 22°.

Anhydrous. Stable on air. (Wheeler.)

Rubidium bromotellurate, Rb_2TeBr_6.

Sol. in a little hot H_2O, but H_2TeO_3 *separates on cooling.*

100 pts. $HBr+Aq$ (sp. gr. 1.49) dissolve 0.25 pt. at 22°.

100 pts. $HBr+Aq$ (sp. gr. 1.08) dissolve 3.88 pts. at 22°. (Wheeler.)

Bromotetramine chromium bromide, $CrBr(NH_3)_4Br_2+H_2O$.

Easily sol. in H_2O. (Cleve.)

— — **chloride,** $CrBr(NH_3)_4Cl_2+H_2O$.

Sol. in H_2O. (Cleve.)

— — **sulphate,** $CrBr(NH_3)_4SO_4+H_2O$.

Easily sol. in H_2O. (Cleve.)

Bromotetramine cobaltic sulphate, $BrCo(NH_3)_4SO_4$, or $Br_2Co_2(NH_3)_8(SO_4)_2$.

Sol. in H_2O. (Vortmann and Blasberg, B. **22.** 2052.)

Cadmium, Cd.

Not attacked by H_2O. Sol. in HCl, or dil. H_2SO_4+Aq, but more easily in HNO_3+Aq. Sol. in $HC_2H_3O_2+Aq$.

Chemically pure Cd like Zn is almost insol. in dil. acids, with the exception of HNO_3. (Weeren, B. 1891, **24.** 1798.)

Sol. in $HClO_3+Aq$ without evolution of H. (Hendrixson, J. Am. Chem. Soc. 1904, **26.** 750.)

Cadmium is sol. in molten $CdCl_2$ and can be recryst. therefrom. (Auerbach, Z. anorg. 1901, **28.** 42.)

From 4 g. Cd in 32 g. molten $CdCl_2$ at 650°, 2.197 g. were dissolved in ½ hr. (Helfenstein, Z. anorg. 1900, **23.** 295.)

Moderately quickly sol. in $K_2S_2O_8+Aq$. More slowly sol. in $(NH_4)_2S_2O_8+Aq$. (Levi, Gazz. ch. it. 1908, **38** (1) 583.)

Sol. in $(NH_3)_2S_2O_8+Aq$ without evolution of gas. (Turrentine, J. phys. Chem. 1907, **11.** 627.)

Sol. in sulphostannates+Aq. (Storch, B. 1883, **16.** 2015.)

½ ccm. oleic acid dissolves 0.0293 g. Cd in 6 days. (Gates, J. phys. Chem. 1911, **15.** 143.)

Not attacked by sugar solution. (Klein and Berg, C. R. **102.** 1170.)

Cadmium amalgam, Cd_2Hg_7.

Stable from 0°–44°. Can be cryst. from Hg without decomp. if temp. does not exceed 44°. (Kerp. Z. anorg. 1900, **25.** 68.)

Cadmium amide, $Cd(NH_2)_2$.

Decomp. by H_2O. (Bohart, J. phys. Chem. 1915, **19.** 543.)

Cadmium arsenide, Cd_3As.

(Descamps, C. R. **86.** 1022.)

Cd_3As_2. Sol. in dil. cold HNO_3. Attacked by aqua regia. (Granger, C. R. 1904, **138.** 575.)

Cadmium azoimide, $Cd(N_3)_2$.

Ppt. (Curtius, J. pr. 1898, (2) **58.** 294.)

Cadmium ***sub*****bromide,** Cd_4Br_7.

Decomp. by H_2O. (Morse and Jones, Am. Ch. J. 1890, **12.** 490.)

Cadmium bromide, $CdBr_2$.

Deliquescent. Very sol. in H_2O.

Solubility in H_2O at t°

t°	% $CdBr_2$	t°	% $CdBr_2$
—4	32.0	48	60.0
—1	34.7	71	61.2
+1	36.3	104	61.8
2	36.0	155	63.7
9	41.9	170	65.2
14	46.0	215	69.9
25	52.6	232	70.1
35	59.6	245	71.5

Solid phase above 100° is $CdBr_2+1\frac{1}{2}H_2O$ (Étard, A. ch. 1894, (7) **2.** 541.)

See also under $CdBr_2+H_2O$ and $CdBr_2+4H_2O$.

Sp. gr. of $CdBr_2+Aq$ at 19.5° containing

5	10	15	20	25	% $CdBr_2$
1.043	1.090	1.141	1.199	1.260	
30	35	40	45	50	% $CdBr_2$
1.326	1.400	1.481	1.578	1.680	

(Kremers, calculated by Gerlach, Z. anal. **8.** 280.)

$CdBr_2+Aq$ containing 18.06% $CdBr_2$ has sp. gr. 20°/20° = 1.1378.

$CdBr_2+Aq$ containing 21.39% $CdBr_2$ has sp. gr. 20°/20° = 1.1666.

(Le Blanc and Rohland, Z. phys. Ch. 1896, **19.** 282.)

Sp. gr. of $CdBr_2+Aq$ containing 35.84% $CdBr_2$ = 1.4231 at 19.4°/4°. (Hallwachs, W. Ann. 1899, **68.** 27.)

Sp. gr. of $CdBr_2$+Aq at 18°/4°.

% $CdBr_2$	33.289	23.973	20.552	11.983
Sp. gr.	1.384	1.252	1.209	1.112
% $CdBr_2$	6.543	3.734	1.927	
Sp. gr.	1.106	1.030	1.017	

(de Muynck, W. Ann. 1894, **53.** 561.)

Sp. gr. of $CdBr_2$+Aq at 18°.

% $CdBr_2$	1	5	10	15	20
Sp. gr.	1.0072	1.0431	1.0907	1.1432	1.1991
% $CdBr_2$	25	30	35	40	43
Sp. gr.	1.2605	1.3296	1.4052	1.4915	1.5467

(Grotrian, W. Ann. 1883, **18.** 193.)

Sp. gr. of $CdBr_2$+Aq.

% $CdBr_2$	t°	Sp. gr. at t°	Sp. gr. at 18°
0.0324	17.90	0.99901	0.99900
	22.75	0.99702	
0.0748	17.23	0.99949	0.99935
	21.50	0.99863	
0.154	17.67	1.00008	1.00002
	23.10	0.99896	
0.253	17.23	1.00119	0.00100
	22.95	0.99986	
0.506	18.07	0.00308	1.00310
	22.65	1.00212	
1.013	18.00		1.00750

(Wershofen, Z. phys. Ch. 1890, **5.** 493.)

Sp. gr. of $CdBr_2$+Aq at 20°.

Normality of $CdBr_2$+Aq	% $CdBr_2$	Sp. gr.
2.774	46.574	1.6198
1.997	37.53	1.4469
0.973	22.53	1.2293
0.5138	12.46	1.1211

(Forchheimer, Z. phys. Ch. 1900, **34.** 29.)

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 827.)

Sol. in $AlBr_3$. (Isbekow, Z. anorg. 1913, **84,** 27.)

Sol. in HCl+Aq, $HC_2H_3O_2$, alcohol, or ether. (Berthemot, A. ch. **44.** 387.)

Sol. in 0.94 pt. H_2O, 3.4 pts. abs. alcohol, 250 pts. ether, and 16 pts. alcohol-ether (1 : 1) (Eder, Dingl. **221.** 89.)

Anhydrous $CdBr_2$ is sol. in acetone. (Krug and M'Elroy.)

1 g. $CdBr_2$ is sol. in 64.5 g. acetone at 18°. Sp. gr. of sat. solution 18°/4° = 0.8073. (Naumann, B. 1904, **37.** 4337.)

Sol. in acetone. (Eidmann, C. C. **1899,** II. 1014.)

Insol. in mustard oil. (Mathews, J. phys. Chem. 1905, **9,** 647.)

Difficultly sol. in methyl acetate. (Naumann, B. 1909, **42,** 3790.)

Insol. in ethyl acetate. (Naumann, B. 1910, **43.** 314.)

Sol. in chinoline. (Beckmann and Gabel, Z. anorg. 1906, **51.** 236.)

100 g. benzonitrile dissolve 0.857 g. $CdBr_2$ at 18°. (Naumann, B. 1914, **47.** 1370.)

Mol. weight determined in piperidine. (Ferchland, Z. anorg. 1897, **15,** 17.)

$+H_2O$. Solubility in H_2O.

100 g. of the sat. solution contain at:

35°	40°	45°	60°	80°	100°
60.29	60.65	60.75	61.10	61.29	61.63 g. $CdBr_2$.

(Dietz, Z. anorg. 1899, **20.** 261.)

$+1\frac{1}{2}H_2O$. (Étard, A. ch. 1894, (7) **2.** 541.)

$+4H_2O$. Efflorescent. (Rammelsberg, Pogg. **55.** 241.)

Solubility in H_2O.

100 g. of the sat. solution contain at:

0°	18°	30°	38°
37.92	48.90	56.90	61.84 g. $CdBr_2$.

Sp. gr. of sat. solution at 18° = 1.683.

(Dietz, Z. anorg. 1899, **20.** 261.)

100 g. sat. solution of $CdBr_2+4H_2O$ in absolute alcohol contain 20.93 g. $CdBr_2$ at 15°.

100 g. sat. solution of $CdBr_2+4H_2O$ in absolute ether contain 0.4 g. $CdBr_2$ at 15°. (Eder, Dingl. **221.** 89.)

Cadmium hydrogen bromide.

Decomp. by H_2O. (Berthelot, C. R. **91.** 1024.)

Cadmium cæsium bromide, $CdBr_2$, CsBr.

Easily sol. in H_2O. (Wells and Walden, Z. anorg. **5.** 270.)

$CdBr_2$, 2CsBr. Decomp. by H_2O into above comp. (W. and W.)

$CdBr_2$,3CsBr. Decomp. by H_2O into $CdBr_2$, CsBr. (W. and W.)

Cadmium potassium bromide, $CdBr_2$, $KBr+\frac{1}{2}H_2O$.

Sol. in 0.79 pt. H_2O at 15°; pptd. by alcohol and ether. (Eder, Dingl. **221.** 89.)

$+H_2O$. Sol. in H_2O without decomp. from 0.4°–112.5°. (Rimbach, B. 1905, **38,** 1554.)

100 pts. of the solution contain at:

0.4°	15.8°	50°	112.5°
53.75	58.68	68.25	78.10 pts. of the salt.

$CdBr_2$, 4KBr. Sol. in 1.40 pts. H_2O at 15°; pptd. by alcohol and ether. (Eder, Dingl. **221.** 89.)

Cannot be prepared in a pure state as it is decomp. by H_2O below 160°. (Rimbach, B. 1905, **38.** 1560.)

Cadmium rubidium bromide, $CdBr_2$, RbBr.

Sol. in H_2O without decomp. from 0.4° to 107.5°.

100 pts. of the solution contain at:

0.4°	14.5°	49.2°	107.5°
32.65	41.87	58.54	75.77 pts. of the salt.

(Rimbach, B. 1905, **38.** 1556.)

$CdBr_2$, 4RbBr. Sol. in H_2O without decomp. from 0.5° to 114.5°.

100 pts. of the solution contain at:

0.5°	13.5°	51.5°	114.5°
47.95	55.17	68.82	79.04 pts. of the salt.

(Rimbach, B. 1905, **38.** 1561.)

Cadmium sodium bromide, $CdBr_2$, $NaBr+2\frac{1}{2}H_2O$.

Sol. at 15° in 1.04 pts. H_2O, 3.7 pts. abs. alcohol, and 190 pts. ether (sp. gr. 0.729). (Eder, Dingl. **221.** 89.)

$3CdBr_2$, $2NaBr+6H_2O$. Stable in conc. solutions and decomp. only by great dilution. (Jones and Knight, Am. Ch. J. 1899, **22.** 134.)

Cadmium bromide ammonia, $CdBr_2$, $2NH_3$.

Can be crystallized out of warm NH_4OH+Aq. (Croft, Phil. Mag. **21.** 356.)

$CdBr_2$, $3NH_3$. (Tassily, C. R. 1897, **124.** 1022.)

$CdBr_2$, $4NH_3$. Decomp. by H_2O. (Croft.)

Cadmium bromide cupric oxide, $CdBr_2$, $3CuO+3H_2O$. (Mailhe, A. ch. 1902, (7) **27.** 383.)

Cadmium bromide hydrazine, $CdBr_2$, $2N_2H_4$.

Easily sol. in NH_4OH+Aq. (Franzen, Z. anorg. 1908, **60.** 280.)

Cadmium bromide hydroxylamine, $CdBr_2$, $2NH_2OH$.

Sol. in hot H_2O with formation of a basic salt. Sol. in dil. acids. Insol. in alcohol and ether. (Adams, Am. Ch. J. 1902, **28.** 218.)

Cadmium *sub*chloride, Cd_4Cl_7.

Decomp. by H_2O and by acids. (Morse and Jones, Am. Ch. J. 1890, **12.** 490.)

Cadmium chloride, $CdCl_2$.

Sol. at	20°	40°	60°	80°	100°	
in	0.71	0.72	0.72	0.70	0.67	pts. H_2O.

(Kremers. Pogg: **103.** 57.)

Sat. $CdCl_2+Aq$ contains % $CdCl_2$ at t°.

t°	%$CdCl_2$	t°	%$CdCl_2$
—7	43.5	120	63.0
+1	47.6	150	64.8
6	49.7	165	68.2
7	51.3	170	68.4
10	51.6	180	70.1
19	52.7	190	71.9
25	52.9	200	72.0
61	57.9	235	76.0
82	58.8	270	77.7

(Étard, A. ch. 1894, (7) **2.** 536.)

100 mol. H_2O dissolve at:

19.3°	29.7°	40.1°	54.5°	
10.94	12.74	13.15	13.16	mol. $CdCl_2$.

(Sudhaus, Miner. Jahrb. Beil.-Bd. 1914, **37.** 19.)

See also under $CdCl_2+H_2O$, $CdCl_2+2\frac{1}{2}H_2O$, and $CdCl_2+4H_2O$.

Sp. gr. of $CdCl_2+Aq$ containing pts. $CdCl_2$ to 100 pts. H_2O.

13	26.9	41	pts. $CdCl_2$,
1.1068	1.2106	1.3100	
55.8	72.5	114.2	pts. $CdCl_2$.
1.4060	1.5060	1.7266	

(Kremers, Pogg. **103.** 57.)

$CdCl_2+Aq$ containing 8.91% $CdCl_2$ has sp. gr. 20°/20° = 1.0715. (Le Blanc and Rohland, Z. phys. Ch. 1896, **19.** 282.)

Sp. gr. of $CdCl_2+Aq$ at room temp. containing:

% $CdCl_2$	11.09	16.30	24.786
Sp. gr.	1.1093	1.1813	1.3199

(Wagner, W. Ann. 1883, **18.** 266.)

Sp. gr. of $CdCl_2+Aq$ at 18°/4°.

% $CdCl_2$	57.524	41.547	29.977
Sp. gr.	1.852	1.515	1.330
% $CdCl_2$	21.431	14.761	
Sp. gr.	1.210	1.142	

(de Muynck, W. Ann. 1894, **53.** 561.)

Sp. gr. of $CdCl_2+Aq$ at 18°.

% $CdCl_2$	1	5	10	[illegible]
Sp. gr.	1.0063	1.0436	1.0919	[illegible]
% $CdCl_2$	20	25	30	[illegible]
Sp. gr.	1.2007	1.2620	1.3305	[illegible]
% $CdCl_2$	40	45	50	
Sp. gr.	1.4878	1.5775	1.6799	

(Grotrian, W. Ann. 1883, **18.** 193.)

Sp. gr. of $CdCl_2+Aq$ at 25°.

Concentration of $CdCl_2+Aq$	Sp. gr.
1–normal	1.0779
1/2– "	1.0391
1/4– "	1.0197
1/8– "	1.0098

(Wagner, Z. phys. Ch. 1890, **5.** 36.)

Sp. gr. of $CdCl_2+Aq$.

%$CdCl_2$	t°	Sp. gr. at t°	Sp. gr.
0.0503	17.59	0.99920	[illegible]
	24.27	0.99781	
0.0999	17.70	0.99964	[illegible]
	22.06	0.99833	
0.200	18.31	1.00038	[illegible]
	24.00	0.99920	
0.399	16.86	1.00239	[illegible]
	24.21	1.00083	
0.599	17.49	1.00406	[illegible]
	25.12	1.00238	
0.769	17.58	1.00580	[illegible]
	21.76	1.00496	
0.997	17.55	1.00754	[illegible]
	19.65	1.00713	

(Wershofen, Z. phys. Ch. 1890, **5.** 402.)

Sp. gr. of $CdCl_2+Aq$ at t°.

t°	Normality of $CdCl_2+Aq$	g. $CdCl_2$ in 100 g. of solution	Sp. gr. [illegible]
20.5	3.80	44.42	[illegible]
"	2.61	34.22	[illegible]
"	1.76	25.90	[illegible]
"	1.29	19.91	[illegible]
"	0.93	14.88	[illegible]
"	0.52	8.84	[illegible]

(Oppenheimer, Z. phys. Ch. 1898, **27.** 444.)

Sp. gr. of $CdCl_2$+Aq at t°.

t°	Concentration of $CdCl_2$+Aq	Sp. gr.
22	1 pt. $CdCl_2$ in 1.3458 pts. H_2O	1.6128
18.7	1 " " " 2.7005 " "	1.2896
17.2	1 " " " 53.988 " "	1.0155
16	1 " " " 54.18 " "	1.0152
17	1 " " " 57.479 " "	1.0136
22	1 " " " 77.232 " "	1.0076

(Hittorf, Z. phys. Ch. 1902, **39.** 628.)

Solubility in KCl+Aq at t°.

t°	100 g. H_2O dissolve		Solid phase
	g. $CdCl_2$	g. KCl	
19.3	111.30	...	$CdCl_2+2\frac{1}{2}H_2O$
	59.59	6.70	$CdCl_2+2\frac{1}{2}H_2O+CdCl_2$, $KCl+H_2O$
	26.98	11.09	$CdCl_2$, $KCl+H_2O$
	11.61	30.04	$CdCl_2$, $KCl+H_2O+CdCl_2$, 4KCl
	1.44	34.76	$CdCl_2$, 4KCl+KCl
	....	33.94	KCl
29.7	129.65	...	$CdCl_2+3\frac{1}{2}H_2O$
	97.62	0.70	$CdCl_2+2\frac{1}{2}H_2O$
	68.23	7.08	$CdCl_2+2\frac{1}{2}H_2O+CdCl_2$, $KCl+H_2O$
	47.12	9.89	$CdCl_2$, $KCl+H_2O$
	32.67	13.06	"
	24.26	16.10	"
	15.99	25.97	"
	15.47	33.58	$CdCl_2$, $KCl+H_2O+CdCl_2$, 4KCl
	2.42	37.66	$CdCl_2$, 4KCl+KCl
	....	37.21	KCl
40.1	133.85	...	$CdCl_2+H_2O$
	92.15	2.70	$CdCl_2+H_2O+CdCl_2$, $KCl+H_2O$
	51.90	11.50	$CdCl_2$, KCl+H-O
	37.91	15.21	"
	24.45	21.73	"
	18.97	35.51	"
	19.92	37.63	$CdCl_2$, $KCl+H_2O+CdCl_2$, 4KCl
	2.98	40.45	$CdCl_2$, 4KCl+KCl
	....	40.36	KCl
54.5	133.90	...	$CdCl_2+H_2O$
	102.15	2.32	$CdCl_2+H_2O+CdCl_2$, $KCl+H_2O$
	44.01	18.39	$CdCl_2$, $KCl+H_2O$
	26.13	43.78	$CdCl_2$, $KCl+H_2O+CdCl_2$, 4KCl
	4.20	45.52	$CdCl_2$, 4KCl+KCl
	....	43.00	KCl

(Sudhaus, Miner. Jahrb. Beil.-Bd. 1914, **37.** 34.)

Solubility in NaCl+Aq at t°.

t°	100 g. H_2O dissolve		Solid phase
	g. $CdCl_2$	g. NaCl	
19.3	111.30	...	$CdCl_2+2\frac{1}{2}H_2O$
	116.64	7.52	$CdCl_2+2\frac{1}{2}H_2O+CdCl_2$, $2NaCl+3H_2O$
	85.15	12.19	$CdCl_2$, $2NaCl+3H_2O$
	40.01	25.67	"
	5.96	36.76	$CdCl_2$, $2NaCl+3H_2O$+ NaCl
	....	35.84	NaCl
29.7	129.65	...	$CdCl_2+2\frac{1}{2}H_2O$
	132.67	9.63	$CdCl_2+2\frac{1}{2}H_2O+CdCl_2$, $2NaCl+3H_2O$
	123.54	10.10	$CdCl_2$, $2NaCl+3H_2O$
	106.16	12.92	"
	91.10	15.41	"
	43 74	27.46	"
	9.43	37.54	$CdCl_2$, $2NaCl+3H_2O$+ NaCl
	....	35.88	NaCl
40.1	133.85	...	$CdCl_2+H_2O$
		15.14	$CdCl_2+H_2O+CdCl_2$, $2NaCl+3H_2O$
	137.03		
	48.17	29.50	$CdCl_2$, $2NaCl+3H_2O$
	13.31	38.16	$CdCl_2$, $2NaCl+3H_2O$+ NaCl
	....	36.18	NaCl
54.5	133.90	...	$CdCl_2+H_2O$
	140.42	19.10	$CdCl_2+H_2O+CdCl_2$, $2NaCl+3H_2O$
	52.76	32.97	$CdCl_2$, $2NaCl+3H_2O$
	22.53	39.07	$CdCl_2$, $2NaCl+3H_2O$+ NaCl
	....	36.82	NaCl

At 34.5°, $CdCl_2+2\frac{1}{2}H_2O \rightarrow CdCl_2+H_2O$ and water.

(Sudhaus, Miner. Jahrb. Beil.-Bd. 1914, **37.** 28.)

Insol. in $SbCl_3$. (Klemensiewicz, C. A. **1909,** 269.)

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 827.)

Insol. or sl. sol. in ethyl alcohol, furfurol, acetophenone, ethyl monochloracetate, ethyl cyanacetate, ethyl oxalate, ethyl nitrate, amyl nitrite, o-nitrotoluene, pyridine, piperidine, and quinoline. Sol. in salicylic aldehyde. (Lincoln, J. phys. Chem. 1899, **3.** 461.)

Insol. in anhydrous ether. (Hampe, Ch. Z. 1887, **II,** 847.)

Readily sol. in alcohol.

100 pts. absolute methyl alcohol dissolve 1.71 pts. $CdCl_2$ at 15.5°.

100 pts. absolute ethyl alcohol dissolve 1.52 pts. $CdCl_2$ at 15.5°. (de Bruyn, Z. phys. Ch. **10.** 783.)

100 g. $CdCl_2+CH_3OH$ contain 1.5 g. $CdCl_2$.

at the critical temp. (Centnerszwer, Z. phys. Ch. 1910, **72.** 437.)

Somewhat sol. in acetone. (Krug and M'Elroy.)

Sol. in acetone; insol. in methylal. (Eidmann, C. C. **1899**, II, 1014.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Sol. in ethyl acetate. (Naumann, B. 1904, **37.** 3601.)

Difficultly sol. in ethylacetate. (Naumann, B. 1910, **43.** 314.)

Sol. in urethane. (Castoro, Z. anorg. 1899, **20.** 61.)

At 18°, 100 g. benzonitrile dissolve 0.06332 g. $CdCl_2$. (Naumann, B. 1914, **47**, 1370.)

Insol. in toluene. (Baxter and Hines, Am. Ch. J. 1904, **31.** 222.)

Sol. in chinolin. (Beckmann and Gabel, Z. anorg. 1906, **51.** 236.)

$+H_2O$. Solubility in H_2O.

100 g. of the sat. solution contain at:

10°	20°	40°	60°
57.47	57.35	57.51	57.77
80°	100°		
58.41	59.52 g. $CdCl_2$.		

110° is bpt. of the sat. solution.

(Dietz, Z. anorg. 1899, **20.** 257.)

$+2\frac{1}{2}H_2O$. Solubility in H_2O.

100 g. of the sat. solution contain at:

−10°	0°	18°	30°	36°
44.35	47.37	52.53	56.27	57.91 g. $CdCl_2$.

Sp. gr. of sat. solution = 1.741.

(Dietz, Z. anorg. 1899, **20.** 257.)

$+4H_2O$. Solubility in H_2O.

100 g. of the sat. solution contain at:

−9°	0°	+10°	+15°
43.58	49.39	55.58	59.12 g. $CdCl_2$.

(Dietz, Z. anorg. 1899, **20.** 257.)

$+5H_2O$. (Worobieff, Z. anorg. 1898, **18.** 386.)

Cadmium hydrogen chloride, $CdCl_2$, $2HCl+7H_2O$.

Decomp. in air. (Berthelot, C. R. **91.** 1024.)

Cadmium cæsium chloride, $CdCl_2$, $2CsCl$.

Easily sol. in H_2O and dil. $HCl+$Aq; insol. in conc. $HCl+$Aq. (Godeffroy, B. **8.** 9.)

Nearly insol. in $CsCl+$Aq. (Wells and Walden, Z. anorg. **5.** 266.)

$CdCl_2$, $CsCl$. Sl. sol. in H_2O; nearly insol. in $CdCl_2+$Aq. (Wells and Walden.)

Cadmium calcium chloride, $2CdCl_2$, $CaCl_2+7H_2O$.

Rather deliquescent, and very sol. in H_2O. When ignited is only sl. sol. in H_2O with evolution of heat. (v. Hauer, J. pr. **63.** 432.)

$CdCl_2$, $2CaCl_2+12H_2O$. Very deliquescent. (v. Hauer.)

Cadmium cobaltous chloride, $2CdCl_2$, $CoCl_2+12H_2O$.

Deliquescent. Sol. in H_2O. (v. Hauer, W. A. B. **17.** 331.)

Cadmium cupric chloride, $CdCl_2$, $CuCl_2+4H_2O$.

Sol. in H_2O. (v. Hauer, W. A. B. **17.** 331.)

Cadmium hydrazine chloride, $CdCl_2$, N_2H_4HCl.

Unstable in the air when moist. Very sol. in H_2O; sl. sol. in alcohol; sol. in NH_3+Aq. (Curtius, J. pr. 1894, (2) **50.** 334.)

$CdCl_2,2N_2H_4HCl+4H_2O$. Very sol. in H_2O; sl. sol. in alcohol. (Curtius, J. pr. 1894, (2) **50.** 335.)

Cadmium iron (ferrous) chloride, $2CdCl_2$, $FeCl_2+12H_2O$.

Sol. in H_2O. (v. Hauer, W. A. B. **17.** 331.)

Cadmium lithium chloride, $CdCl_2$, $LiCl+3\frac{1}{2}H_2O$.

Very deliquescent. Decomp. by solution in H_2O, but not in alcohol. (Chassevant, A. ch. (6) **30.** 39.)

Cadmium magnesium chloride, $2CdCl_2$, $MgCl_2+12H_2O$.

D[illegible] in moist, stable in dry air. [illegible]$_2$O with absorption of heat. Much more sol. in hot than in cold H_2O. (v. Hauer.)

Solubility in H_2O at t°.

t°	G. Cd_2MgCl_6 in 100 g. solution	G. Cd_2MgCl_6 in 100 g. H_2O
2.4	45.61	83.86
20.8	49.69	98.77
45.5	53.51	115.10
67.2	58.14	138.90
121.8	65.48	189.69

(Rimbach, B. 1897, **30.** 3084.)

$CdCl_2$, $2MgCl_2+12H_2O$. Very deliquescent. (v. Hauer.)

Cadmium manganese chloride, $2CdCl_2$, $MnCl_2+12H_2O$.

Deliquescent in moist, efflorescent in dry air. Sol. in H_2O. (v. Hauer.)

Cadmium nickel chloride, $CdCl_2$, $2NiCl_2+12H_2O$.

Sol. in H_2O. (v. Hauer, W. A. B. **20.** 40.)

$2CdCl_2$, $NiCl_2+12H_2O$. Sol. in H_2O. (v. Hauer.)

Cadmium potassium chloride, $CdCl_2$, $KCl+\frac{1}{2}H_2O$.

Sol. in H_2O without decomp. (v. Hauer.)

$+H_2O$. 100 mol. H_2O dissolve at:

19.3°	29.7°	40.1°	54.5°
2.65	3.21	3.72	4.33 mol. $CdCl_2$, $KCl+H_2O$.

(Sudhaus, Miner. Jahrb. Beil.-Bd. 1914, **37.** 26.)

Solubility in H_2O at t°.

t°	G. $CdKCl_3$ in 100 g. solution	G. $CdKCl_3$ in 100 g. H_2O
2.6	21.87	27.99
15.9	26.60	36. 4
41.5	35.66	55.34
60.6	40.67	68.55
105.1	51.67	106.91

(Rimbach, B. 1897, **30.** 3079.)

$CdCl_2$, 2KCl. 100 pts. H_2O at 15.5° dissolve 33.45 pts. Sl. sol. in alcohol. (Croft, Phil. Mag. (3) **21.** 356.)

Solubility in salts+Aq at 16°.

$CdCl_2$, 2KCl is sol. without decomp. in the following salt solutions at 16°.

Salt	Mols. salt in 100 mols H_2O	In 1 litre of the solution mole			Sp. gr. of the solution
		$CdCl_2$	KCl	RCl	
LiCl	9.3	0.166	0.663	4.483	1.1380
$CaCl_2$	3.8	0.270	1.080	1.887	1.2333
KCl	2.378	0.507	3.195	...	1.214

(Rimbach, B. 1905, **38.** 1568,)

$CdCl_2$, 4KCl. More sol. in H_2O than $CdCl_2$, KCl. (v. Hauer.)

100 g. H_2O dissolve at:

19.3°	29.7°	40.1°	54.5°
41.65	49.05	57.55	69.91 g. $CdCl_2$, 4KCl.

(Sudhaus, Miner. Jahrb. Beil.-Bd. 1914, **37.** 24.)

Solubility in H_2O at t°.

t°	100 pts. solution contain pts.		
	Cd	Cl	K
4.0	3.64	9.84	8.31
23.6	5.66	14.02	11.52
50.2	9.10	18.09	13.60
108.8	11.97	23.08	17.10
109.0	11.91	23.15	17.22

(Rimbach, B. 1897, **30.** 3080.)

Decomp. by H_2O.

Can be recryst. without decomp. from LiCl, $CaCl_2$, or $MgCl_2$+Aq. (Rimbach, B. 1905, **38.** 1565.)

The salt is sol. [illegible] HCl+Aq containing 19.8 [illegible] mole H_2O at 16°.

1 l. of the solution contains 0.033 mole $CdCl_2$, 0.132 mole KCl and 8.828 mole HCl; sp. gr. of the solution = 1.1403. (Rimbach, B. 1905, **38.** 1568.)

Cadmium rubidium chloride, $CdCl_2$, 2RbCl.

Sol. in H_2O and HCl+Aq. (Godeffroy, B. **8.** 9.)

$CdCl_2$, RbCl. Solubility in H_2O at t°.

100 pts. by wt. of the solution contain pts. by wt. RbCl, $CdCl_2$.

t°	Pts. RbCl, $CdCl_2$
1.2	12.97
14.5	16.80
41.4	25.31
57.6	30.83
103.9	46.62

$CdCl_2$, RbCl is sol. in H_2O without decomp. from 0–104°. (Rimbach, B. 1902, **35.** 1303.)

$CdCl_2$, 4RbCl.

Solubility of $CdCl_2$, 4RbCl and $CdCl_2$, RbCl in H_2O at t°.

t°	In 100 pts. by wt. of the solution			Composition of the solid phase	
	Pts. by wt. Cd	Pts. by wt. Cl	Pts. by wt. Rb	Mol.-% mono-salt	Mol.-% tetra-salt
0.7	0.65	6.52	14.73	30	70
8.8	1.07	7.37	16.13	24	76
13.8	1.32	7.86	16.93	16	84
42.4	3.21	11.35	22.45	14	86
59.0	4.61	13.41	25.31	33	67
108.4	8.94	18.57	31.15	..	..

(Rimbach, B. 1902, **35.** 1305.)

Decomp. by H_2O between 0° and 108°. (Rimbach, B. 1905, **38.** 1571.)

Sol. in conc. HCl without decomp. (Rimbach, B. 1905, **38.** 1571.)

Not sol. in $CaCl_2$+Aq and LiCl+Aq without decomp. (Rimbach, B. 1905, **38.** 1571.)

Cadmium sodium chloride, $CdCl_2$, $2NaCl+3H_2O$.

Sol. in 1.4 pts. H_2O at 16°. (Croft.)

100 mol. H_2O dissolve at:

19.3°	29.7°	40.1°	54.5°
3.93	4.29	4.73	5.18 mol. $CdCl_2$, $2NaCl+3H_2O$.

Stable between 19° and 55°.

(Sudhaus, Miner. Jahrb. Beil.-Bd. 1914, **37.** 25.)

Sl. sol. in alcohol or wood alcohol. (Croft.)

Cadmium strontium chloride, $2CdCl_2$, $SrCl_2+7H_2O$.

Sol. in H_2O. (v. Hauer.)

Cadmium chloride ammonia, $CdCl_2$, $2NH_3$.

Nearly insol. in H_2O. (v. Hauer.)

$CdCl_2$, $3NH_3+\frac{1}{4}H_2O$.

$CdCl_2$, $4NH_3+\frac{1}{2}H_2O$.

$CdCl_2$, $5NH_3$. (André, C. R. **104.** 908.)

$CdCl_2$, $6NH_3$. Difficultly sol. in cold H_2O. (Schüler, A. **87.** 34.)

Cadmium chloride cupric oxide, $CdCl_2$, $3CuO+3H_2O$.

Not decomp. by H_2O. (Mailhe, A. ch. 1902, (7) **27.** 378 and 174.)

Cadmium chloride hydrazine, $CdCl_2$, $2N_2H_4$.

Insol. in H_2O.

Sol. in NH_4OH+Aq. (Franzen, Z. anorg. 1908, **60.** 279.)

$+H_2O$. Insol. in H_2O; easily sol. in NH_4OH+Aq. (Curtius, J. pr. 1894, (2) **50.** 345.)

Cadmium chloride hydroxylamine, $CdCl_2$, $2NH_2OH$.

Sl. sol. in cold, somewhat more in warm H_2O. Very sol. in hydroxylamine+Aq. Very sl. sol. in alcohol and other organic solvents. (Crismer, Bull. Soc. (3) **3.** 116.)

Aq solution sat. at 20° contains about 1%. (Antonoff, C. C. **1905**, II. 810.)

Cadmium fluoride, CdF_2.

Difficultly sol. in H_2O. Easily sol. in HF+Aq. (Berzelius, Pogg. **1.** 26.)

Very sol. in H_2O; insol. in 95% alcohol; sol. in HCl, H_2SO_4, or HNO_3+Aq with evolution of HF. (Poulenc, C. R. **116.** 582.)

1 l. H_2O dissolves 0.289 mol. CdF_2 at 25°, or 100 cc. sat. aqueous solution contains 4.36 g. CdF_2 at 25°. (Jaeger, Z. anorg. 1901, **27.** 35.)

1 l. of 1.08-N HF dissolves 0.372 mol. CdF_2 at 25°. (Jaeger, Z. anorg. 1901, **27.** 35.)

Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 827.)

Cadmium ceric fluoride, $CdF_2,2CeF_4+7H_2O$.

Ppt. Decomp. by H_2O. (Rimbach, A. 1909, **368.** 106.)

Cadmium columbium fluoride.

See **Fluocolumbate, cadmium.**

Cadmium molybdenyl fluoride.

See **Fluoxymolybdate, cadmium.**

Cadmium silicon fluoride.

See **Fluosilicate, cadmium.**

Cadmium stannic fluoride.

See **Fluostannate, cadmium.**

Cadmium titanium fluoride.

See **Fluotitanate, cadmium.**

Cadmium zirconium fluoride.

See **Fluozirconate, cadmium.**

Cadmous hydroxide, CdOH.

Insol. in H_2O. Decomp. by acids into cadmic salt. (Morse and Jones, Am. Ch. J. **12.** 488.)

Cadmium hydroxide, CdO_2H_2.

Insol. in H_2O.

1 l. CdO_2H_2+Aq contains 0.0026 g. CdO_2H_2 at 25°. (Bodländer, Z. phys. Ch. 1898, **27.** 66.)

Solubility in $H_2O = 2.6 \times 10^{-4}$. (Herz, Z. anorg. 1900, **24.** 126.)

Sol. in acids; very sol. in NH_4OH+Aq; insol. in KOH, NaOH, Na_2CO_3, K_2CO_3, and $(NH_4)_2CO_3$+Aq.

Easily sol. in $(NH_4)_2SO_4$, NH_4Cl, NH_4NO_3, and NH_4 succinate+Aq. (Wittstein.)

Freshly pptd. CdO_2H_2 is sol. in alkali haloids+Aq. (Bersch, Z. phys. Ch. 1891, **8.** 392.)

Solubility in NH_4OH+Aq increases with increase in concentration of NH_4OH. (Euler, B. 1903, **36.** 3401.)

Solubility in NH_4OH+Aq at 25°.

NH_3 norm.	g. CdO per l.
0.5	0.24
1.0	0.62
1.8	1.33
4.6	4.92

(Bonsdorff, Z. anorg. 1904, **41.** 187.)

Insol. in ethyl, and methyl amine+Aq. (Wurtz.)

Very sl. sol. in HCN+Aq even when freshly pptd. (Schüler, A. **87.** 48.)

Not pptd. in presence of Na citrate (Spiller), and many non-volatile organic substances. (Rose.)

Cadmium iodide, CdI_2.

Sol. in 1.13 pts. H_2O at 15°. (Eder, Dingl. **221.** 89.)

Sol. at	20°	40°	60°	80°	100°
in	1.08	1.00	0.93	0.86	0.75 pts. H_2O.

(Kremers, Pogg. **103.** 57.)

Sat. CdI_2+Aq contains at:

−4°	+2°	+10°	13°	24°	32°
42.4	43.7	45.2	44.8	46.5	47.4% CdI_2.
54°	64°	76°	94°	95°	135°
49.5	50.1	52.4	55.1	54.7	62.9% CdI_2.
140°	165°	185°	202°	202°	255°
63.1	68.1	70.7	73.4	73.2	84.5% CdI_2.

(Étard, A. ch. 1894, (7) **2.** 545.)

Solubility in H_2O.

100 g. of the sat. solution contain at:

0°	18°	50°	75°	100°
44.39	46.02	49.35	52.65	56.08 g. CdI_2.

(Dietz, Z. anorg. 1899, **20.** 262.)

Sp. gr. of CdI_2+Aq containing pts. CdI_2 to 100 pts. H_2O.

21.4	43.7	88.5 pts. CdI_2.
1.1681	1.328	1.6139

(Kremers, Pogg. **111.** 60.)

Sp. gr. of CdI_2+Aq at 19.5° containing:

5	10	15	20	25	% CdI_2,
1.044	1.088	1.138	1.194	1.253	
30	35	40	45	50	% CdI_2.
1.319	1.395	1.476	1.575	1.680	

(Kremers, calculated by Gerlach, Z. anal. **8.** 285.)

Sp. gr. of CdI_2+Aq at 18°.

% CdI_2	1	5	10	15	20
Sp. gr.	1.0071	1.0425	1.0883	1.1392	1.1943
% CdI_2	25	30	35	40	45
Sp. gr.	1.2550	1.3228	1.4000	1.4816	1.5741

(Grotrian, W. Ann. 1883, **18.** 193.)

Sp. gr. of CdI_2+Aq.

g. CdI_2 per l.	Sp. gr.	g. CdI_2 per l.	Sp. gr.
98.85	1.08	289.5	1.237
197.7	1.162	400	1.328

(Barbier and Roux, Bull. Soc. 1890, (3) **3.** 425.)

Sp. gr. of CdI_2+Aq.

% CdI_2	t°	Sp. gr. at t°	Sp. gr. at 18°
0.0429	17.68	0.99915	0.99908
	22.88	0.99807	
0.100	17.55	0.99965	0.99956
	22.91	0.99363	
0.204	17.76	1.00052	1.0005
	22.79	0.99948	
0.399	17.40	0.00223	1.0021
	24.30	1.00082	
0.600	18.00		1.0038
0.800	17.44	1.00564	1.0056
	23.11	1.00442	
1.00	18.00		1.0072

(Wershofen, Z. phys. Ch. 1890, **5.** 493.)

Sp. gr. CdI_2+Aq at 18°/4° containing:

31.123	13.677	9.559	% CdI_2.
1.338	1.125	1.086	

(de Muynck, W. Ann. 1894, **53.** 561.)

CdI_2+Aq containing 10.97% CdI_2 has sp. gr. 20°/20° = 1.0982.

CdI_2+Aq containing 16.53% CdI_2 has sp. gr. 20°/20° = 1.1562.

(Le Blanc and Rohland, Z. phys. Ch. 1896, **19.** 282.)

Sp. gr. of CdI_2+Aq at 20°.

Normality of CdI_2+Aq	% CdI_2	Sp. gr.
1.924	44.53	1.5807
0.951	27.07	1.2837
0.447	14.40	1.1355
0.211	7.26	1.0630

(Forchheimer, Z. phys. Ch. 1900, **34.** 29.)

CdI_2+Aq containing 1 pt. CdI_2 in 2.2691 pts. H_2O at 17° has sp. gr. = 1.3341. (Hittorf, Z. phys. Ch. 1902, **39.** 628.)

Sol. in sat. HI+Aq.

Sol. in warm NH_4OH+Aq.

Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 827.)

Sl. sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 827.)

Sol. in S_2Cl_2. (Walden, Z. anorg. 1900, **25.** 217.)

Difficultly sol. in $POCl_3$. (Walden, Z. anorg. 1900, **25.** 212.)

Nearly insol. in $AsBr_3$. (Walden, Z. anorg. 1902, **29.** 374.)

Sol. in SO_2Cl_2. (Walden, Z. anorg. 1900, **25.** 215.)

Sol. in 15 pts. alcohol. (Vogel, N. Rep. Pharm. **12.** 393.)

Sol. in 0.98 pt. abs. alcohol. (Eder, Dingl. **221.** 89.)

Sp. gr. of CdI_2+alcohol.

% CdI_2	Sp. gr. 20°/20°
0	0.7949
7.28	0.8470

(Le Blanc and Rohland, Z. phys. Ch. 1896, **19.** 284.)

Sol. in 5.2 mols. methyl, 7 mols. ethyl, and 9.8 mols. propyl alcohol at 20°. (Timofejew, C. R. **112.** 1224.)

Sol. in 3.6 pts. ether. (Eder, *l. c.*)

Sol. in 2.0 pts. alcohol-ether (1 : 1). (Eder, *l. c.*)

Very sl. sol. in anhydrous abs. ether. (Hampe, Ch. Z. 1887, **11.** 847.)

100 g. of sat. solution in abs. ether contain 0.143 g. CdI_2 at 12°. (Tyrer, Proc. Chem. Soc. 1911, **27.** 142.)

Solubility in ether+Aq at 12°.

% H_2O in ether	% CdI_2	% H_2O in ether	% CdI_2	% H_2O in ether	% CdI_2
0.0	0.143	0.50	3.36	1.00	7.30
0.10	0.78	0.70	4.77	1.10	8.27
0.30	2.07	0.90	6.46	1.14	8.68

(Tyrer, Proc. Chem. Soc. **27.** 142.)

Solubility in benzene	at 16°	= 0.01%
	" 35°	= 0.02%
Solubility in ethyl ether	at 0°	= 0.03%
	" 15.5°	= 0.04%
	" 20.3°	= 0.05%

(Linebarger, Am. J. Sci. 1895, (3) **49.** 52.)

Sol. in acetone. (Eidmann, C. C. **1899,** II. 1014.)

1 g. CdI_2 is sol. in 4 g. acetone at 18°. Sp. gr. of sat. solution 18°/4° = 0.994. (Naumann, B. 1904, **37.** 4338.)

Sp. gr. of CdI_2+acetone.

% CdI_2	Sp. gr. 20°/20°.
0	0.7998
12.02	0.8929

(Le Blanc and Rohland, Z. phys. Ch. 1896, **19.** 284.)

Sol. in chinolin. (Beckmann and Gabel, Z. anorg. 1906, **51.** 236.)

100 g. benzonitrile dissolve 1.6295 g. CdI_2 at 18°. (Naumann, B. 1914, **47.** 1370.)

Insol. in methylene iodide. (Retgers, Z. anorg. **3.** 343.)

Sl. sol. in ethylamine. (Shinn, J. phys. Chem. 1907, **11.** 538.)

Insol. in CS_2. (Arctowski, Z. anorg. 1849, **6.** 257.)

Solubility in methyl acetate=0.7–1.5%; 2.1% at bpt. (Schröder and Steiner, J. pr. 1909, (2) **79.** 49.)

Sol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

1 pt. is sol. in 54.3 pts. ethyl acetate at 18°. The sat. solution has D18°/4°=0.9145. (Naumann, B. 1910, **43.** 318.)

Insol. in mustard oil. (Mathews, J. phys. Chem. 1905, **9.** 647.)

Mol. weight determined in piperidine, pyridine, methyl and ethyl sulphide. (Werner, Z. anorg. 1897, **15.** 17.)

Cadmium hydrogen iodide, CdI_2, $HI+3H_2O$.

Decomp. in air. (Dobroserdow, C. C. **1900,** II. 527.)

Cadmium cæsium iodide, CdI_2, $CsI+H_2O$.

Sol. in H_2O without decomp. (Wells and Walden, Z. anorg. **5.** 271.)

CdI_2, 2CsI. As above.

CdI_2, 3CsI. Decomp. by H_2O into the above salt.

Cadmium hydrazine iodide, CdI_2,$2N_2H_4HI$.

Sol. in H_2O. (Ferratini, C. A. **1912.** 1612.)

Cadmium mercuric iodide.

Very sol. in H_2O. (Berthemot, J. Pharm. **14.** 613.)

CdI_2, $3HgI_2$. Sol. in H_2O. Can be recrystallized in alcohol. (Clarke and Kebler, Am. Ch. J. **5.** 235.)

Cadmium potassium iodide, CdI_2, $KI+H_2O$.

Sol. in 0.94 pt. H_2O at 15°. (Eder, Dingl. **221.** 89.)

CdI_2, $2KI+2H_2O$. D[illegible] Extremely sol. in H_2O. So[illegible] pt. H_2O. Sl. sol. in alcohol and wood spirit, but less than CdI_2. (Croft.)

Sol. at 15° in 1.4 pts. absolute alcohol, 24.5 pts. ether (0.729 sp. gr.), and 4.5 pts. alcohol-ether (1 : 1). (Eder, *l. c.*)

Sp. gr. of K_2CdI_4+Aq at 18°.

%K_2CdI_4	1	5	10	15	20
Sp. gr.	1.0065	1.0384	1.0808	1.1269	1.1770

%K_2CdI_4	25	30	35	40	45
Sp. gr.	1.2313	1.2890	1.3557	1.4282	1.5065

(Grotrian, W. Ann. 1883, **18.** 193.)

Sp. gr. of K_2CdI_4+Aq.

%K_2CdI_4	t°	Sp. gr. at t°	Sp. gr. at 18°
0.0328	18		0.99895
0.0596	18		0.99921
0.0804	18		0.99938
0.100	17.12	0.99962	0.99945
	21.82	0.99872	
0.250	18		1.0007
0.500	18		1.0027
1.003	17.32	1.0068	1.0067
	20.63	1.0061	

(Wershofen, Z. phys. Ch. 1890, **5.** 493.)

Sol. in ethyl acetate. (Naumann, B. 1904, **37.** 3601.)

Cadmium sodium iodide, CdI_2, $2NaI+6H_2O$.

Deliquescent. (Croft.)

Sol. at 15° in 0.63 pt. H_2O, 0.86 pt. abs. alcohol, and 10.1 pts. ether (sp. gr. 0.729). (Eder, Dingl. **221.** 89.)

Cadmium strontium iodide, CdI_2, SrI_2+ $8H_2O$.

Deliquesces in moist, effloresces in dry air; sol. in H_2O. (Croft.)

Cadmium iodide ammonia, CdI_2, $2NH_3$.

Decomp. by H_2O. (Rammelsberg.)

CdI_2, $4NH_3$. (Dawson and McCrae, Chem. Soc. 1900, **77.** 1246.)

CdI_2, $6NH_3$. Decomp. by H_2O; sol. in warm, less sol. in cold NH_4OH+Aq. (Rammelsberg.)

Cadmium iodide hydrazine, CdI_2, $2N_2H_4$.

Easily sol. in warm NH_4OH+Aq. (Franzen, Z. anorg. 1908, **60.** 281.)

Cadmium iodide hydroxylamine, CdI_2, $3NH_2OH$.

Sol. in H_2O and alcohol. Insol. in ether. (Adams, Am. Ch. J. 1902, **28.** 218.)

Cadmium iodide selenide, CdI_2, 3CdSe.

Easily decomp. (Fonzes-Diacon, C. R. 1900, **131.** 897.)

Cadmium iodosulphide, CdI, 2CdS.

Ppt. (Naumann, B. 1904, **37.** 4338.)

Cadmium *sub*oxide, Cd_4O.

Decomp. by H_2O, acids and NH_4OH+ Aq. (Tanatar, Z. anorg. 1901, **27.** 433.)

Cd_2O. Properties as cadmous hydroxide. (Morse and Jones.)

Cadmium oxide, CdO.

Insol. in H_2O. Sol. in acids. Sol. in NH_4OH+Aq. Insol. in $(NH_4)_2CO_3$+Aq. Easily sol. in NH_4Cl+Aq, less in NH_4NO_3+ Aq. (Brett, **1837.**)

Insol. in KOH, NaOH, K_2CO_3, and Na_2CO_3 +Aq.
See also **Cadmium hydroxide.**

Solubility in (calcium sucrate+sugar)+Aq.
1 l. solution containing 418.6 g. sugar and 34.3 g. CaO dissolves 0.22 g. CdO.
1 l. solution containing 174.4 g. sugar and 14.1 g. CaO dissolves 0.48 g. CdO.
(Bodenbender, J. B. **1865.** 600.)
Insol. in acetone. (Naumann, B. 1904, **37.** 4329.)
Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)
Insol. in ethyl acetate. (Naumann, B. 1904, **37.** 3601.)

Cadmium ***per*****oxide,** Cd_5O_8 or Cd_3O_5(?).
(Haas.)
CdO_2, $Cd(OH)_2$. (Kouriloff, A. ch. (6) **23.** 431.)
Very stable towards H_2O. Insol. in NH_4OH +Aq. (Haas, B. 1884, **17.** 2253.)
$4CdO_2$, $Cd(OH)_2$. Ppt. Insol. in NaOH+Aq. (Eÿkmann, C. C. **1905,** I. 1629.)
$5CdO_2$,$CdO+3H_2O$. Ppt. (Teletow, C. A. **1912,** 43.)

Cadmium oxybromide, CdO, $CdBr_2+H_2O$.
Decomp. by H_2O. (Tassily, C. R. 1897, **124.** 1023.)
$+2H_2O$. Stable in dry air; insol. in H_2O. (Tassily, C. R. 1897, **124.** 1022.)
$+3H_2O$. Slowly decomp. by H_2O. (Tassily, C. R. 1897, **124.** 1022.)
$+7H_2O$. (Mailhe, C. R. 1901, **132.** 1561.)

Cadmium oxychloride, $CdCl_2$, $CdO+H_2O$.
Sl. sol. in hot H_2O. (Habermann, M. Ch. **5.** 432.)
$+7H_2O$. (Mailhe, Bull. Soc. 1901, (3) **25.** 791.)
2CdO, $CdCl_2$. Insol. in H_2O, but slowly decomp. thereby. (Canzoneri, Gazz. ch. it. 1897, **27.** (2) 486.)

Cadmium oxyiodide, CdO, CdI_2+H_2O.
Decomp. by H_2O. (Tassily, C. R. 1897, **124.** 1023.)
$+3H_2O$. Stable in dry air; insol. in H_2O. (Tassily, C. R. 1897, **124.** 1022.)

Cadmium phosphide, Cd_3P_2.
Sol. in HCl+Aq with evolution of PH_3. (Stromeyer.)
Cd_2P. Sol. in conc. HCl+Aq. (Emmerling, B. **12.** 152.)
Easily decomp. by acids. (Kulisch, A. **231.** 327.)
CdP_2. Decomp. by boiling conc. HCl+Aq. (Renault, C. R. **76.** 283.)

Cadmium selenide, CdSe.
Sol. in HCl+Aq. (Uelsmann, A. **116.** 122.)
Easily decomp. by acids. (Fonzes-Diacon, C. R. 1900, **131.** 897.)

Cadmium sulphide, CdS.
Insol. in H_2O.
Solubility in H_2O at 16-18° = 6.6×10^{-6} mols. per l. (Biltz, Z. phys. Ch. 1907, **58.** 291.)
1 l. H_2O dissolves 9.00×10^{-6} mols. CdS (artificial greenockite) at 18°.
1 l. H_2O dissolves 8.86×10^{-6} mols. pptd. CdS at 18°. (Weigel, Z. phys. Ch. 1907, **58.** 294.)
Difficultly sol. in hot dil. HCl+Aq. Easily sol. in cold conc. HCl+Aq. (Stromeyer.) Sol. in HNO_3+Aq (Meissner), and boiling dil. H_2SO_4+Aq (1 : 6). (A. W. Hoffmann, A. **115.** 286.) Very sl. sol. in NH_4OH+Aq. (Wackenroder, Repert. **46.** 226.) Insol. in KOH, or $(NH_4)_2S$+Aq. Appreciably sol. in an acid solution of NH_4Cl. (Baxter and Hines, Z. anorg. 1905, **44.** 160.)
Much more sol. in $(NH_4)_2S$+Aq than usually supposed. (Ditte, C. R. **85.** 402.). Solubility increases by warming, and at 68° is twice that at ordinary temperatures. A sat. solution of $(NH_4)_2S$ dissolves about 2 g. CdS to a litre. Alkali sulphides dissolve much less. (Ditte.)
Fresenius (Z. anal. **20.** 236) could not confirm the above. According to Fresenius, CdS is not appreciably sol. in $(NH_4)_2S$+Aq.
Insol in Na_2SO_3 or KCN+Aq. (Fresenius.)
Insol. in NH_4Cl or NH_4NO_3+Aq. (Brett.)
Sol. in alkali sulpho-molybdates, -tungstates, -vanadates, -arsenates, -antimonates, -stannates+Aq. (Storch, B. **16.** 2015.)
Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 827.)
Insol. in acetone. (Naumann, B. 1904, **37.** 4329; Eidmann, C. C. **1899,** II. 1014.)
Insol. in ethyl acetate. (Naumann, B. 1910, **43.** 314.)
Min. *Greenockite.* Sol. in HCl+Aq.

Colloidal.—Solution of 4 g. colloidal C in a litre H_2O remains transparent several days. If it contains 11 g. CdS in a litre, it is completely coagulated in 24 hours. Solutions of salts of the following concentration cause an immediate coagulation in an aqueous solution of CdS containing 3.62 g. in a litre.

KCl	1 : 1615
KBr	1 : 727
KI	1 : 57
KCN	1 : 166
$KClO_3$	1 : 1666
KNO_3	1 : 1000
$K_2S_2O_8$	1 : 5000
K_2SO_4	1 : 833
$K_3Fe(CN)_6$	1 : 166
$K_4Fe(CN)_6$	<1 : 100
K_2CrO_4	1 : 400
$K_2Cr_2O_7$	1 : 3571
NaCl	1 : 2666
$Na_2S_2O_3$	1 : 98
$NaHCO_3$	1 : 333
Na_2CO_3	1 : 166
Na_2HPO_4	1 : 202

$NaC_2H_3O_2$	1 : 2451
Na benzoate	1 : 10,000
$(NH_4)_2C_2O_4$	1 : 588
$BaCl_2$	1 : 11,764
$Ba(NO_3)_2$	1 : 8032
BaS_2O_6	1 : 5617
$MgSO_4$	1 : 41,666
$MnSO_4$	1 : 22,222
$CdSO_4$	1 : 250,000
$Cd(NO_3)_2$	1 : 285,714
$Pb(ClO_3)_2$	1 : 209
$Pb(C_2H_3O_2)_2$	1 : 147,058
$Hg(CN)_2$	<1 : 20
$Al_2(SO_4)_3$	1 : 232,558
Alum	1 : 192,377
Chrome alum	1 : 42,555
HCl	1 : 4807
H_2SO_4	1 : 8000
$HC_2H_3O_2$	1 : 15
$H_2C_2O_4$	1 : 23,255
Succinic acid	<1 : 100
Tartaric acid	1 : 333

(Prost, Belg. Acad. Bull. (3) **14.** 312; J. B. **1887.** 537.)

Cadmium *penta*sulphide, CdS_5.

Insol. in H_2O. (Schiff, A. **115.** 74.)

Mixture of CdS and S. (Follenius, Z. anal. **13.** 412.)

Cadmium potassium sulphide, $K_2Cd_3S_4$.

(Milbauer, Z. anorg. 1904, **42.** 439.)

Cadmium sodium sulphide, 3CdS, Na_2S.

Decomp. by H_2O. (Schneider, J. pr. (2) **8.** 29.)

Cadmium sulphoiodide.

See **Cadmium iodosulphide.**

Cadmium telluride, CdTe.

Not attacked by dil. acids. Attacked in the cold only by HNO_3. (Tibbals, J. Am. Chem. Soc. 1909, **31.** 908.)

Cadmic acid.

Potassium cadmate.

Insol. in H_2O, but gradually decomp. when in contact therewith. (Meunier, C. R. **63.** 330.)

Cæsium, Cs.

Decomp. H_2O with great violence. (Setterberg, A. **211.** 100.)

Very sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 827.)

Cæsium acetylide acetylene, Cs_2C_2, C_2H_2.

Insol. in C_6H_6 and in $CHCl_3$. (Moissan, C. R. 1903, **136.** 1218.)

Cæsium amide, $CsNH_2$.

Decomp. by H_2O. Very sol. in liquid NH_3. (Rengade, C. R. 1905, **140.** 1185.)

Cæsium ammonia, Cs,NH_3.

Sol. in liquid NH_3. (Moissan, C. R. 1903, **136.** 1177.)

Cæsium azoimide, CsN_3.

Deliquescent. Stable in aq. solution.

224.2 pts. sol. in 100 pts. H_2O at 0°
307.4 " " " 100 " H_2O " 16°
1.0366 " " " 100 " abs. alcohol " 16°

Insol. in pure ether. (Curtius, J. pr. 1898, (2) **58.** 283.)

Cæsium bromide, CsBr.

Ppt. (Chabrié, C. R. 1901, **132.** 679.)

Sat. CsBr+Aq at 25° contains 55.23% CsBr. (Foote, Am. Ch. J. 1907, **37.** 125.)

Cæsium *tri*bromide, $CsBr_3$.

Sol. in H_2O; decomp. by alcohols. (Wells, Sill. Am. J. **143.** 17.)

Cæsium *penta*bromide, $CsBr_5$.

Very unstable. (Wells and Wheeler, Sill. Am. J. **144.** 42.)

Cæsium cobalt bromide, Cs_2CoBr_4.

Decomp. by H_2O. (Campbell, Z. anorg. 1894, **8.** 126.)

Decomp. by H_2O and by alcohol. (Campbell, Am. J. Sci. 1894, (3) **48.** 418.)

Cs_3CoBr_5. Decomp. by H_2O. (Campbell, Z. anorg. 1894, **8.** 126.)

Decomp. by H_2O and by alcohol. (Campbell, Am. J. Sci. 1894, (3) **48.** 418.)

Cæsium copper bromide, CsBr, $CuBr_2$.

Sol. in H_2O without decomp. (Wells and Walden, Z. anorg. **5.** 304.)

2 CsBr, $CuBr_2$. (W. and W.)

Cæsium iridium bromide.

See **Bromiridate, cæsium.**

Cæsium iron (ferric) bromide, $CsFeBr_4$.

Sol. in H_2O. (Walden, Z. anorg. 1894, **7.** 332.)

$Cs_2FeBr_5+H_2O$. (Walden, Z. anorg. 1894, **7.** 332.)

Cæsium lead bromide, CsBr, $2PbBr_2$.

Nearly stable in aqueous solution. (Walden, Sill. Am. J. **145.** 127.)

CsBr, $PbBr_2$. Decomp. by H_2O. (Walden.)

4CsBr, $PbBr_2$. As above.

Solubility determinations show that the double salts formed by cæsium and lead bromides at 25° are $CsPb_2Br_5$, $CsPbBr_3$ and Cs_4PbBr_6. (Foote, Am. Ch. J. 1907, **37.** 125.)

Cæsium magnesium bromide, CsBr, $MgBr_2$+$6H_2O$.

Sol. in H_2O. (Wheeler and Campbell, Z. anorg. **5.** 275.)

Cæsium mercuric bromide, $CsBr, 2HgBr_2$.

Not decomp. by H_2O. 100 pts. solution sat. at 16° contain 0.807 pt. $CsBr, 2HgBr_2$. Sl. sol. in hot strong alcohol, from which $CsBr, HgBr_2$ separates on cooling. (Wells, Sill. Am. J. **144.** 221.)

$CsBr, HgBr_2$. Decomp. by H_2O into above salt. Sol. in alcohol without decomp. (Wells.)

$2CsBr, HgBr_2$. Decomp. by H_2O into $CsBr, 2HgBr_2$.

$3CsBr, HgBr_2$. As above.

Cæsium molybdenyl bromide, $2CsBr, MoOBr_3$.

(Weinland and Knöll, Z. anorg. 1905, **44.** 107.)

Cæsium nickel bromide, $CsNiBr_3$.

Decomp. by H_2O. (Campbell, Z. anorg. 1894, **8.** 126.)

Decomp. by H_2O and by alcohol. (Campbell, Am. J. Sci. 1894, (3) **48.** 418.)

Cæsium osmium bromide.

See **Bromosmate, cæsium.**

Cæsium palladium bromide.

See **Bromopalladate, cæsium** and **bromopalladite, cæsium.**

Cæsium platinum bromide.

See **Bromoplatinate, cæsium.**

Cæsium ruthenium bromide.

See **Bromoruthenite, cæsium.**

Cæsium selenium bromide.

See **Bromoselenate, cæsium.**

Cæsium tellurium bromide.

See **Bromotellurate, cæsium.**

Cæsium thallic bromide, $CsBr, TlBr_3$.

Sol. in H_2O with decomp. (Pratt, Z. anorg. 1895, **9.** 19.)

By recryst. from H_2O, forms $3CsBr, 2TlBr_3$. (Pratt, Am. J. Sci. 1895, (3) **49.** 403.)

$3CsBr, 2TlBr_3$. Can be recryst. unchanged from H_2O. (Pratt, Am. J. Sci. 1895, (3) **49.** 402.)

Cæsium tin (stannic) bromide.

See **Bromostannate, cæsium.**

Cæsium zinc bromide, $3CsBr, ZnBr_2$.

Sol. in H_2O. (Wells and Campbell, Z. anorg. **5.** 275.)

$2CsBr, ZnBr_2$. As above.

Cæsium bromide columbium oxybromide, $2CsBr, CbOBr_3$.

Unstable in moist air. Decomp. by H_2O. (Weinland, B. 1906, **39.** 3059.)

Cæsium bromochloride, $CsBr_2Cl$.

Properties as $CsBr_3$. (Wells.)

$CsBrCl_2$. As above. (Wells.)

Cæsium mercuric bromochloride, $Cs_3HgCl_3Br_2$.

Decomp. by H_2O finally to $HgBr_2$. (Wells, Sill. Am. J. **144.** 121.)

Cs_2HgCl_2Br. As above.

$CsHgClBr_2$. As above.

$CsHg_2ClBr_4$. As above.

$CsHg_5ClBr_{10}$. As above.

Cæsium bromochloroiodide, $CsBrClI$.

More sol. in H_2O than in alcohol. Not decomp. at once by ether. (Wells.)

Cæsium bromoiodide, $CsBrI_2$.

Decomp. by H_2O. Sol. in alcohol. Decomp. by ether with residue of CsBr. (Wells, Sill. Am. J. **143.** 17.)

$CsBr_2I$. More sol. in H_2O than in alcohol. Not decomp. by ether.

$CsBr_2I$+Aq sat. at 20° contains about 4.45% $CsBr_2I$. (Wells.)

Cæsium carbide, Cs_2C_2.

Decomp. by cold H_2O. (Moissan, C. R. 1903, **136.** 1221.)

Cæsium chloride, CsCl.

Very deliquescent; sol. in H_2O and alcohol.

Solubility of CsCl at t°.

t°	Pts. by wt. of CsCl in 100 pts. solution
0.3	61.9
10	63.5
20	64.9
30	66.3
40	67.4

(Hinrichsen, Z. phys. Ch. 1904, **50.** 99.)

Solubility of CsCl at t°.

t°	% CsCl	t°	% CsCl
0	61.7	60	69.7
10	63.6	70	70
20	65.1	80	71.4
30	66.4	90	72.2
40	67.5	100	73.0
50	68.0	119.4	74.4

(Berkeley, Trans. Roy. Soc. 1904, **203.** A. 208.)

A normal solution of CsCl has sp. gr. at 25°=1.1076. (Wagner, Z. phys. Ch. 1890, **5.** 36.)

Sp. gr. at 20°/4° of a normal solution of CsCl=1.125815. (Haigh, J. Am. Chem. Soc. 1912, **34.** 1151.)

Sp. gr. of CsCl+Aq.

G. equiv. CsCl per l. at 18°	Sp. gr. at 6°/6°	Sp. gr. at 18°/18°	Sp. gr. at 30°/30°
0.504	1.06556	1.06483	1.06452
1.002	1.12962	1.12825	1.12750
2.007	1.25705	1.25452	1.25307
3.994	1.50514	1.50100	1.49859

(Clausen, W. Ann. 1914, (4) **44.** 1071.)

Solubility of $CsCl+FeCl_3$ in H_2O at 21°.

Substance added		Pts. by weight in 100 pts. of solution	
$FeCl_3$ grams	CsCl grams	$FeCl_3$	CsCl
0	65	0	65.0
0.6	11.6	0.45	55.18
1.4	10.2	2.1	52.38
2.2	8.8	5.24	51.44
2.0	7.4	7.8	47.70
3.8	6.0	8.93	41.15
4.6	4.6	15.34	25.25
5.4	2.8	21.65	14.96
6.2	1.4	27.96	8.42
35	0.2	48.71	0.94
35	0	83.89	0

(Hinrichsen, Z. phys. Ch. 1904, **50.** 96.)

Solubility of $CsCl+HgCl_2$ in H_2O at 25°.

Solution contains		Solid phase
% CsCl	% $HgCl_2$	
65.61	0.00	CsCl
65.78	0.215	$CsCl+Cs_3HgCl_5$
62.36	0.32	Cs_3HgCl_5
57.01	0.64	"
52.35	1.23	"
51.08	1.44	$Cs_3HgCl_5+Cs_2HgCl_4$
49.30	1.49	Cs_2HgCl_4
45.95	1.69	"
45.23	1.73	$Cs_2HgCl_4+CsHgCl_3$
38.63	1.32	$CsHgCl_3$
17.03	0.51	"
1.53	0.42	"
0.61	2.64	$CsHgCl_3+CsHg_2Cl_5$
0.49	2.91	$CsHg_2Cl_5$
0.40	3.78	$CsHg_2Cl_5+CsHg_5Cl_{11}$
0.44	4.63	"
0.41	4.68	$CsHg_5Cl_{11}$
0.25	5.65	"
0.18	7.09	$CsHg_5Cl_{11}+HgCl_2$.
0.00	6.90	$HgCl_2$

(Foote, Am. Ch. J. 1903, **30.** 340.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329; Eidmann, C. C. **1899,** II. 1014.)

100 g. solution in acetone sat. at 25° contain 0.032 g. CsCl. (Foote and Haigh, J. Am. Chem. Soc. 1911, **33.** 461.)

Solubility of $CsCl+HgCl_2$ in acetone at 25

Solution contains		Solid phase
% $HgCl_2$	% CsCl	
57.74	0.00	$HgCl_2$
57.79	0.13	$HgCl_2+CsHg_5Cl_{11}$
57.74	0.20	$CsHg_5Cl_{11}$
52.54	0.22	"
49.83	0.32	"
44.32	0.50	$CsHg_5Cl_{11}+CsHg_2Cl_5$
44.46	0.44	"
39.65	0.48	$CsHg_2Cl_5$
28.48	0.48	"
26.96	0.52	$CsHg_2Cl_5+CsHgCl_3$
27.32	0.61	"
21.50	0.46	$CsHgCl_3$
13.08	0.45	"
0.16	0.19	Mixtures of salts
0.17	0.25	"
0.02	0.11	"
0.00	0.032	CsCl

(Foote and Haigh, J. Am. Ch. Soc. 1911, **33.** 461.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Solubility in glycol at ord. temp. 10.6–10.8%. (de Coninck, Belg. Acad. Bull. **1905.** 359.)

Insol. in anhydrous pyridine and in 97% pyridine+Aq. Sl. sol. in 95% pyridine+Aq and in 93% pyridine+Aq. (Kahlenberg, J. Am. Chem. Soc. 1908, **30.** 1107.)

Cæsium chromium chloride, $2CsCl,CrCl_3+H_2O$.

Stable in the air. Sol. in H_2O. (Wells, Z. anorg. 1895, **10.** 182.)

$2CsCl,CrCl_3+4H_2O$; hydroscopic; very sol in H_2O. (Wells, *l. c.*)

Cæsium *tetra-aquo***chromium chloride,** $CrCl_2(OH_2)_4.Cl, 2CsCl$.

Ppt. (Werner, B. 1901, **34.** 1602.)

Cæsium cobalt chloride, $CsCoCl_3+2H_2O$.

Decomp. by H_2O and alcohol. (Campbell. Z. anorg. 1894, **8.** 126.)

Cs_2CoCl_4. Decomp. by H_2O and by al[illegible] (Campbell, Z. anorg. 1894, **8.** 126.)

[illegible] Decomp. by H_2O and by alcohol. (Campbell, Z. anorg. 1894, **8.** 126.)

Cæsium cuprous chloride, $CsCl, Cu_2Cl_2$.

Decomp. by H_2O into $CuCl_2$, CsCl. (Wells, Z. anorg. **5.** 306.)

$3CsCl, Cu_2Cl_2$. (Wells.)

$6CsCl, Cu_2Cl_2$. (Wells.)

Cæsium cupric chloride, $2CsCl, CuCl_2$.

Easily sol. in H_2O and dil. HCl+Aq; insol. in conc. HCl+Aq. (Godeffroy, B. **8.** 9.)

Sol. in small amount H_2O without decomp. (Wells and Dupee, Z. anorg. **5.** 300.)

$+2H_2O$. Efflorescent. (W. and D.)

$3CsCl, 2CuCl_2+2H_2O$.

$CsCl, CuCl_2$. Sol. in H_2O without decomp. (W. and D.)

Cæsium gold chloride.

See **Chloraurate, cæsium.**

Cæsium iridium *tetra*chloride.

See **Chloriridate, cæsium.**

Cæsium iron (ferric) chloride, $CsFeCl_4+\frac{1}{2}H_2O$.

Sol. in H_2O. Decomp. in the air. (Walden, Z. anorg. 1894, **7.** 332.)

$Cs_2FeCl_5+H_2O$. Sol. in H_2O. (Walden.)

$Cs_3FeCl_6+H_2O$. Sol. in H_2O. (Walden.)

Cæsium lanthanum chloride, $Cs_3LaCl_6+4H_2O$.

Very hydroscopic. Easily sol. in H_2O. (R. J. Meyer, Z. anorg. 1914, **86.** 273.)

Cæsium lead chloride, $CsCl, 2PbCl_2$.

Nearly stable in aqueous solution. (Campbell, Sill. Am. J. **145.** 126.)

$CsCl, PbCl_2$. Decomp. by H_2O. (Campbell.)

$4CsCl, PbCl_2$. As above. (Campbell.)

Cæsium lead *tetra*chloride.

See **Chloroplumbate, cæsium.**

Cæsium magnesium chloride, $CsCl, MgCl_2+6H_2O$.

Sol. in H_2O. (Wells and Campbell, Z. anorg. **5.** 275.)

Cæsium manganous chloride, $CsCl, MnCl_2+2H_2O$.

Not deliquescent; sol. in H_2O. (Saunders, Am. Ch. J. **14.** 143.)

$2CsCl, MnCl_2$. (Godeffroy.)

$+2\frac{1}{2}H_2O$. (Godeffroy.)

$+3H_2O$. Sol. in H_2O. Conc. $HCl+Aq$ precipitates anhydrous salt from aqueous solution. (Godeffroy, B. **8.** 9.)

The only salt which exists contains $2H_2O$. (Saunders, Am. Ch. J. **14.** 143.)

Cæsium manganic chloride, $2CsCl, MnCl_3$.

Easily decomp. (Meyer and Best, Z. anorg. 1899, **22.** 187.)

Cæsium mercuric chloride, $CsCl, HgCl_2$.

100 pts. solution sat. at 17° contain 1.406 pts. $CsHgCl_3$. Not decomp. by H_2O. Insol. in absolute alcohol, but sol. on diluting with $^1/_3$ vol. H_2O. (Wells, Sill. Am. J. **144.** 221.)

$2CsCl, HgCl_2$. Easily sol. in H_2O and dil. $HCl+Aq$; insol. in conc. $HCl+Aq$. (Godeffroy.)

$3CsCl, HgCl_2$. Decomp. by H_2O; on recrystallizing from H_2O, $CsCl, HgCl_2$ is finally formed. (Wells, Sill. Am. J. **144.** 221.)

$CsCl, 5HgCl_2$. Decomp. by H_2O. (Wells.)

Solubility determinations show that the only double [illegible] and $HgCl_2$ which exist at 25° are Cs_3HgCl_5, Cs_2HgCl_4, $CsHgCl_3$, $CsHg_2Cl_5$, $CsHg_5Cl_{11}$. (Foote, Am. Ch. J. 1903, **30.** 340.)

Cæsium molybdenum chloride, $Cs_2MoCl_5+H_2O$.

Sol. in H_2O. Nearly insol. in alcohol and ether. (Chilesotti, C. C. **1903,** II. 652.)

Cæsium molybdenyl chloride, $CsCl, MoO_2Cl_2+H_2O$.

Hygroscopic. Decomp. by H_2O. (Weinland and Knöll, Z. anorg. 1905, **44.** 93.)

$2CsCl, MoO_2Cl_2$. Hygroscopic. Decomp. by H_2O. (Weinland and Knöll, Z. anorg. 1905, **44.** 92.)

$2CsCl, 6MoO_2Cl_2+22H_2O$. Very hygroscopic. Decomp. by H_2O. (Weinland and Knöll, Z. anorg. 1905, **44.** 94.)

$2CsCl, MoOCl_3$. Only sl. sol. in H_2O. (Nordenskjöld, B. 1901, **34.** 1573.)

Cæsium neodymium chloride, $Cs_3NdCl_6+5H_2O$.

Very hydroscopic. Easily sol. in H_2O. (R. J. Meyer, Z. anorg. 1914, **86.** 273.)

Cæsium nickel chloride, $2CsCl, NiCl_2$.

As the corresponding Cu salt.

$CsNiCl_3$. Decomp. by H_2O and by alcohol. (Campbell, Am. J. Sci. 1894, (3) **48.** 418.)

Cæsium palladium *di*chloride.

See **Chloropalladite, cæsium.**

Cæsium palladium *tetra*chloride.

See **Chloropalladate, cæsium.**

Cæsium praseodymium chloride, $Cs_3PrCl_6+5H_2O$.

Very hydroscopic. Easily sol. in H_2O. (R. J. Meyer, Z. anorg. 1914, **86.** 273.)

Cæsium rhodium chloride.

See **Chlororhodite, cæsium.**

Cæsium ruthenium chloride.

See **Chlororuthenite, cæsium and chlororuthenate, cæsium.**

Cæsium *oxy*ruthenium chloride, $Cs_2RuO_2Cl_4$.

Ppt.; decomp. by H_2O; sol. in cold HCl. (Howe, J. Am. Chem. Soc. 1901, **23.** 779.)

Cæsium samarium chloride, $Cs_3SmCl_6+5H_2O$.

Very hydroscopic. Easily sol. in H_2O. (R. J. Meyer, Z. anorg. 1914, **86.** 273.)

Cæsium silver chloride, 2CsCl, AgCl.

Easily decomp. by H_2O. (Wells and Wheeler, Sill. Am. J. **144.** 155.)

Cæsium tellurium chloride.

See **Chlorotellurate, cæsium.**

Cæsium thallic chloride, 2CsCl, $TlCl_3$.

By recryst. from H_2O forms 3CsCl, $2TlCl_3$. (Pratt, Am. J. Sci. 1895, (3) **49.** 398.)

$+H_2O$. Readily sol. in hot H_2O but 3CsCl, $2TlCl_3$ cryst. from the solution. (Pratt, Am. J. Sci. 1895, (3) **49.** 399.)

3CsCl, $2TlCl_3$. Can be recryst. from H_2O without change. (Pratt, Am. J. Sci. 1895, (3) **49.** 401.)

3CsCl, $TlCl_3+2H_2O$. Sol. in 36.4 pts. H_2O at 17° and 3 pts. at 100°. (Godeffroy, Zeitsch. d. allgem. österr. Apothekerv. **1880.** No. 9.)

Cæsium tin (stannic) chloride.

See **Chlorostannate, cæsium.**

Cæsium titanium chloride, $TiCl_3$, 2CsCl+H_2O.

Difficultly sol. in H_2O. (Stähler, B. 1904, **37.** 4409.)

Cæsium tungsten chloride, $Cs_3W_2Cl_9$.

Nearly insol. in cold H_2O.

Sol. in a hot mixture of equal pts. H_2O and conc. HCl.

Nearly insol. in conc. HCl.

Sol. in very dil. NaOH+Aq.

Nearly insol. in most organic solvents. (Olsson, B. 1913, **46.** 574.)

Cæsium uranous chloride, Cs_2UCl_6.

As K salt. (Aloy, Bull. Soc. 1899, (3) **21.** 264.)

Cæsium uranyl chloride, 2CsCl, $(UO_2)Cl_2$.

Sol. in H_2O. (Wells, Z. anorg. 1895, **10.** 183.)

100 pts. of the solution contain at 29.75°, 56.07 pts. UO_2Cl_2, 2CsCl. (Rimbach, B. 1904, **37.** 468.)

Pptd. from aq. solution by gaseous HCl. (Wells, Am. J. Sci. 1894, (3) **50.** 251.)

Cæsium vanadium chloride, $Cs_2VdCl_5+H_2O$.

Difficultly sol. in H_2O and alcohol. (Stähler, B. 1904, **37.** 4412.)

Cæsium zinc chloride, 3CsCl, $ZnCl_2$.

Sol. in H_2O. (Wells and Campbell, Z. anorg. **5.** 275.)

2CsCl, $ZnCl_2$. Easily sol. in H_2O and dil. HCl+Aq. Insol. in conc. HCl+Aq. (Godeffroy.)

Cæsium chloride chromic oxychloride, 2CsCl, $CrOCl_3$.

Decomp. in the air.

Sol. in conc. HCl without decomp. (Weinland, B. 1906, **39.** 4045.)

Cæsium chloride columbium oxychloride, 2CsCl, $CbOCl_3$.

Decomp. by H_2O. (Weinland, B. 1906, **39.** 3057.)

Cæsium chloroiodide, $CsCl_2I$.

Properties as CsBrClI. (Wells.)

$CsCl_4I$. Sl. sol. in H_2O, from which it can be recrystallized without decomp. (Wells and Wheeler.)

Cæsium mercuric chloroiodide, $Cs_2HgCl_2I_2$.

Decomp. instantly by H_2O to HgI_2. (Wells.)

Cæsium fluoride, CsF.

Ppt. (Chabrié, C. R. 1901, **132.** 680.)

$+1\frac{1}{2}H_2O$. 100 g. H_2O dissolve 366.5 g CsF at 15°. (de Forcrand, C. R. 1911, **152.** 1210.)

Cæsium hydrogen fluoride, $CsHF_2$.

Ppt. (Chabrié, C. R. 1901, **132.** 680.)

Cæsium tantalum fluoride.

See **Fluotantalate, cæsium.**

Cæsium tellurium fluoride, CsF,TeF_4.

Decomp. by H_2O. (Wells, Am. J. Sci. 1901, (4) **12.** 190.)

Cæsium titanium fluoride.

See **Fluotitanate, cæsium.**

Cæsium zirconium fluoride.

See **Fluozirconate, cæsium.**

Cæsium hydride, CsH.

Decomp. by H_2O with evolution of H_2. (Moissan, C. R. 1903, **136.** 589.)

Cæsium hydroxide, CsOH.

Very deliquescent, and sol. in H_2O. Sol. in alcohol.

79.41% CsOH is contained in a sat. aq. solution at 15°. (de Forcrand, C. R. 1909, **149.** 1344.)

75.08% CsOH is contained in sat. aq. solution at 30°. (Schreinemakers, C. C. **1909,** I. 11.)

Cæsium iodide, CsI.

Sol. in H_2O.

100 pts. H_2O dissolve 44 pts. CsI at 0°; 66.3 pts. at 14.5°; 160 pts. at 61°.

Sp. gr. of CsI+Aq sat. at 14°=1.393. (Betekoff, Bull. Soc. Pétersb. (4) **2.** 197.)

Cæsium *per*iodide.

Solubility determinations show that CsI_3 and CsI_5 are the only periodides of cæsium existing between —4° and +73°. (Foote, Am. Ch. J. 1903, **29.** 203.)

Cæsium *tri*iodide, CsI_3.

1 ccm. sat. CsI+Aq dissolves 0.0097 g. CsI_3, and sp. gr. of solution is 1.154. Only sl. decomp. by solution in H_2O. Much more sol. in alcohol than in H_2O. Not immediately decomp. by ether. (Wells, Sill. Am. J. **143.** 17.)

Cæsium *penta*iodide, CsI_5.

Cæsium cobalt iodide, Cs_2CoI_4.

Decomp. by H_2O. (Campbell, Z. anorg. 1894, **8.** 12.)

Deliquescent; decomp. by H_2O and by alcohol. (Campbell, Am. J. Sci. 1894, (3) **48.** 418.)

Cæsium lead iodide, $CsPbI_3$.

Sl. sol. in hot CsI+Aq. (Wheeler, Sill. Am. J. **145.** 129.)

Cæsium mercuric iodide, CsI, $2HgI_2$.

Decomp. by H_2O finally into HgI_2. (Wells, Sill. Am. J. **144.** 221.)

2CsI, $3HgI_2$. Decomp. by H_2O finally into HgI_2.

CsI, HgI_2. As above.

2CsI, HgI_2. Decomp. by H_2O; insol. in alcohol.

3CsI, HgI_2. As above.

Cæsium silver iodide, CsI, AgI.

(Penfield, Z. anorg. **1.** 100.)

CsI, 2AgI. More sol. in hot than in cold acetone. (Marsh, Chem. Soc. 1913, **103.** 782.)

Cæsium tellurium iodide.

See **Iodotellurate, cæsium.**

Cæsium thallic iodide, CsI, TlI_3.

Decomp. by H_2O. (Pratt, Am. J. Sci. 1895, (3) **49.** 403.)

Cæsium zinc iodide, 3CsI, ZnI_2.

Sol. in H_2O. (Wells and Campbell, Z. anorg. **5.** 275.)

2CsI, ZnI_2. As above.

Cæsium oxide, Cs_2O.

Absorbs H_2O and CO_2 from the air. Decomp. by H_2O and by liquid NH_3. (Rengade, C. R. 1906, **143.** 593.)

Cæsium *di*oxide, Cs_2O_2.

Decomp. by H_2O. (Rengade, C. R. 1905, **140.** 1537.)

Cæsium *tri*oxide, Cs_2O_3.

Decomp. by H_2O. (Rengade, C. R. 1905, **140.** 1537.)

Cæsium *tetr*oxide, Cs_2O_4.

Decomp. by H_2O. (Rengade, C. R. 1905, **140.** 1538.)

Cæsium sulphide, Cs_2S+4H_2O.

Deliquescent; very sol. in H_2O. (Biltz, Z. anorg. 1906, **48.** 300.)

Cæsium *di*sulphide, Cs_2S_2.

Anhydrous. Sol. in H_2O. Hydroscopic. (Biltz, Z. anorg. 1906, **50.** 72.)

$+H_2O$. From Cs_2S_2+Aq. Hydroscopic. (Biltz, Z. anorg. 1906, **50.** 72.)

Cæsium *tri*sulphide, Cs_2S_3.

Anhydrous. Sol. in H_2O. Not hydroscopic. (Biltz, Z. anorg. 1906, **50.** 75.)

$+H_2O$. From Cs_2S_3+Aq. (Biltz, Z. anorg. 1906, **50.** 76.)

Cæsium *tetra*sulphide, Cs_2S_4.

Sol. in H_2O. Insol. in abs. alcohol. (Biltz, Z. anorg. 1906, **48.** 305.)

Cæsium *penta*sulphide, Cs_2S_5.

Mpt. 2°. Not hydroscopic. Very sol. in cold 70% alcohol. (Biltz, B. 1905, **38.** 129.)

Cæsium hydrogen sulphide, CsHS.

Deliquescent; very sol. in H_2O. (Biltz, Z. anorg. 1906, **48.** 300.)

Cæsium copper *tetra*sulphide, $CsCuS_4$.

Sl. sol. in cold H_2O.

Decomp. by conc. and dil. HCl, H_2SO_4 and HNO_3.

Sl. sol. in alcohol. (Biltz, B. 1907, **40.** 978.)

Calcium, Ca.

Decomp. H_2O violently. Slowly attacked by cold H_2SO_4. Dil. H_2SO_4+Aq or HCl+Aq attack violently and dissolve. Dil. HNO_3+Aq oxidizes, but fuming HNO_3 scarcely attacks even on boiling. (Bunsen and Matthiessen.) Not attacked by anhydrous alcohol. (Lies-Bodart and Jobin, A. ch. (3) **54.** 364.)

Pure Ca is only very slowly decomp. by H_2O at ordinary temp.; sol. in HCl, HNO_3, H_2SO_4. (Moissan, C. R. 1898, **129.** 589.)

Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 827.)

½ ccm. oleic acid dissolves 0.0334 g. Ca in 6 days. (Gates, J. phys. Chem. 1911, **15.** 143.)

Calcium amalgam, Ca_3Hg_4.

Decomp. H_2O readily. (Feré, C. R. 1898, **127.** 619.)

$CaHg_5$. Rapidly decomp. in moist air. (Schürger, Z. anorg. 1900, **25.** 425.)

Calcium amide, $Ca(NH_2)_2$.

(Moissan, A. ch. 1899, (7) **18.** 326.)

Calcium ammonia, Ca, $4NH_3$.

Decomp. at ordinary temp.; takes fire in contact with the air; sl. sol. in liquid NH_3. (Moissan, C. R. 1898, **127.** 691.)

Ca,$6NH_3$. (Kraus, J. Am. Chem. Soc. 1908, **30.** 665.)

Calcium arsenide, Ca_3As_2.

Decomp. by cold H_2O; insol. in cold fuming HNO_3; very sol. in hot HNO_3. (Lebeau, C. R. 1899, **128.** 98.)

Calcium azoimide, $Ca(N_3)_2$.

Hydroscopic; explosive.

38.1 pts. sol. in	100 pts.	H_2O	at 0°
45.0 " "	" 100 "	H_2O	" 15.2
0.211 " "	" 100 "	abs. alcohol	" 16.

Sol. in H_2O; decomp. when heated and on standing in the air. (Dennis, Z. anorg. 1898, **17.** 21.)

Insol. in pure ether. (Curtius, J. pr. 1898, (2) **58.** 286.)

Calcium boride, CaB_6.

Not decomp. by H_2O at 250°; sol. in fused oxidizing agents.

Insol. in aq. acids; sl. sol. in conc. H_2SO_4; sol. in dil. or conc. HNO_3. (Moissan, C. R. 1897, **125.** 631–32.)

Calcium bromide, $CaBr_2$.

Very deliquescent. 100 pts. H_2O dissolve—

at 0°	20°	40°	60°	105°
125	143	213	278	312 pts. $CaBr_2$.

(Kremers, Pogg. **103.** 65.)

Sat. $CaBr_2$+Aq contains at:

—22°	—22°	—14°	—7°	—5°
50.5	50.2	52.5	52.6	52.6% $CaBr_2$
+8°	9°	11°	20°	50°
53.1	55.1	55.7	57.1	62.6% $CaBr_2$

(Étard, A. ch. 1894, (7) **2.** 540.)

Sp. gr. of $CaBr_2$+Aq at 19.5° containing:

5	10	15	20	25 %$CaBr_2$,
1.044	1.089	1.139	1.194	1.252
30	35	40	45	50 % $CaBr_2$.
1.315	1.385	1.461	1.549	1.641

(Kremers, Pogg. **99.** 444, calculated by Gerlach, Z. anal. **8.** 285.)

Sl. sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 827.)

Very sol. in alcohol. (Henry.)

Sol. in acetone. (Eidmann, C. C. **1899,** II. 1014; Naumann, B. 1904, **37.** 4328.)

Sol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Sol. in ethyl acetate. (Naumann, B. 1910, **43.** 314.)

Insol. in benzonitrile. (Naumann, B. 1914, **47.** 1370.)

+$4H_2O$. (Kuznetzov, C. A. **1911.** 842.)

+$6H_2O$.

Calcium manganous bromide, $CaMnBr_4$+$4H_2O$.

Sl. hydroscopic. Unstable. (Ephraim, Z. anorg. 1910, **67.** 377.)

Calcium mercuric bromide.

Decomp. by H_2O. (v. Bonsdorff.)

Calcium molybdenyl bromide, $CaBr_2$, $2MoOBr_3$+$7H_2O$.

(Weinland and Knöll, Z. anorg. 1905, **44.** 112.)

Calcium stannic bromide.

See **Bromostannate, calcium.**

Calcium bromide ammonia, $CaBr_2$, $6NH_3$.

Sol. in H_2O. (Rammelsberg, Pogg. **55.** 239.)

Calcium bromide hydrazine, $CaBr_2$, $3N_2H_4$.

Easily sol. in H_2O. (Franzen, Z. anorg. 1908, **60.** 288.)

Calcium bromofluoride, $CaBr_2$, CaF_2.

Decomp. by H_2O. (Defacqz, A. ch. 1904, (8) **1.** 357.)

Calcium carbide, CaC_2.

Sp. gr. 2.22 at 18°. Insol. in fuming HNO_3 and conc. H_2SO_4 but readily decomp. by dil. acids and H_2O. (Moissan, Bull. Soc. 1894, (3) **11.** 1005.)

Insol. in HCl in the cold, but decomp. at red heat. Strong min. acids do not act in the cold; sol. in glacial acetic in the cold; sol. in fused alkali. (Venable, J. Am. Chem. Soc. 1895, **17.** 307–310.)

Calcium chloride, $CaCl_2$.

Very deliquescent. Very sol. in H_2O with evolution of heat.

Anhydrous $CaCl_2$ is sol. in 1.459 pts. H_2O. (Gerlach.)

Anhydrous $CaCl_2$ is sol. in 1.58 pts H_2O at 10.2°. (Kremers, Pogg. **103.** 65.)

Anhydrous $CaCl_2$ is sol. in 1.33 pts. H_2O at 20°, 0.83 pt. H_2O at 40°; 0.72 pt. H_2O at 60°. $CaCl_2$+$6H_2O$ is sol. in 0.5 pt. H_2O at 0°, and 2.05 pt. at 16°. (Gmelin.)

$CaCl_2$ is sol. in 1.5 pts. cold, and 0.8 pt. boiling H_2O. (Fourcroy.)

$CaCl_2$+Aq sat. in the cold contains 40.7% $CaCl_2$. (Fourcroy.)

$CaCl_2$+Aq sat. at 12.5° contains 53.8% $CaCl_2$. (Hassenfratz.)

100 pts. H_2O dissolve 165.7 pts. $CaCl_2$+$6H_2O$ at 0°; 7141 pts. at 40°. (Tilden, Chem. Soc. **45.** 409.)

100 pts. H_2O dissolve 60.3 pts. $CaCl_2$ from $CaCl_2$+$6H_2O$ at 0°, and solution has sp. gr. = 1.367. (Engel, Bull. Soc. (2) **47.** 318.)

Solubility of $CaCl_2+6H_2O$ in H_2O at t°.

t°	Sat. solution contains % $CaCl_2$	Sat. solution contains % $CaCl_2+6H_2O$
—22	32.24	63.61
0	36.91	72.82
+ 7.39	38.77	76.49
13.86	41.03	80.95
19.35	42.50	83.85
23.46	44.15	87.11
24.47	45.33	89.44
27.71	46.30	91.35
29.53	50.67	99.97

(Hammerl, W.A.B. **72**, **2.** 287.)

Solubility in 100 pts. H_2O at t°.

t°	Pts. $CaCl_2$	t°	Pts. $CaCl_2$
0	59.39	13.86	69.49
5	64.83	19.35	73.91
7.88	66.20	21.89	79.77

(Hammerl, calculated by Bakhuis Roozeboom, R. t. c. **8.** 5.)

Solubility in 100 pts. H_2O at t°.

t°	Pts. $CaCl_2$	t°	Pts. $CaCl_2$	t°	Pts. $CaCl_2$
0	49.6	19	72	38	108
1	50	20	74	39	109
2	51	21	75	40	110
3	52	22	77	41	111
4	53	23	79	42	112
5	54	24	80	43	113
6	55	25	82	44	114
7	56	26	84	45	115
8	57	27	87	46	116
9	58	28	89	47	117
10	60	29	91	48	118
11	61	30	93	49	119
12	62	31	96	50	120
13	63	32	98	51	121
14	65	33	100	52	122
15	66	34	103	53	123
16	68	35	104	54	124
17	69	36	105	55	125
18	71	37	107	56	126
57	127	72	137	87	145
58	128	73	138	88	146
59	129	74	138	89	147
60	129	75	139	90	147
61	130	76	139	91	148
62	131	77	140	92	149
63	131	78	141	93	150
64	132	79	141	94	150
65	133	80	142	95	151
66	133	81	142	96	152
67	134	82	143	97	152
68	135	83	143	98	153
69	135	84	144	99	154
70	136	85	144	179.5	325
71	136	86	145	...	...

(Mulder, Scheik. Verhandel. **1864.** 107.)

If solubility S=pts. anhydrous $CaCl_2$ in 100 pts. solution, S=32+0.2148t from —18° to +6°; S=54.5+0.0755t from 50° to 120°. (Étard, C. R. **98.** 1432.)

According to Bakhuis Roozeboom, the solubility of $CaCl_2$ varies according to the hydrate employed, and the following data were obtained as the result of very exact experiments.

Solubility of $CaCl_2+6H_2O$ in 100 pts. H_2O at t°.

t°	Pts. $CaCl_2$	t°	Pts. $CaCl_2$	t°	Pts. $CaCl_2$
20.4	75.1	28.0	88.8	29.5	96.07
25.05	81.67	28.9	92.05	30.2	102.7

There are two modifications of $CaCl_2+4H_2O$, α and β.

Solubility of $CaCl_2+4H_2O\beta$ in 100 pts. H_2O at t°.

t°	Pts. $CaCl_2$	t°	Pts. $CaCl_2$
18.4	103 3	35.0	122.74
25 0	108.8	38.4	127.50
30.0	114.1	....	....

Solubility of $CaCl_2+4H_2O\alpha$ in 100 pts. H_2O at t°.

t°	Pts. $CaCl_2$	t°	Pts. $CaCl_2$
22.0	92.67	35.95	107.21
24 7	95.59	40.00	115.3
29 8	100.6	45.00	129.9

Solubility of $CaCl_2+2H_2O$ in 100 pts. H_2O at t°.

t°	Pts. $CaCl_2$	t°	Pts. $CaCl_2$	t°	Pts. $CaCl_2$
40	128.1	95.8	156.5	139	191.0
45	129.9	115	169.5	155	214.3
50	132.3	124	176.0	165	236.2
59.5	136.5	137	187.6	174	275.7
80.5	145.3	...	...	...	..

Solubility of $CaCl_2+H_2O$ in 100 pts. H_2O at t°.

t°	Pts. $CaCl_2$
191	306
235	331

(Bakhuis Roozeboom, R. t. c. **8.**1.)

Sp. gr. of $CaCl_2$+Aq.

% $CaCl_2$	Sp. gr.	% $CaCl_2$	Sp. gr.	% $CaCl_2$	Sp. gr.
3.95	1.03	20.85	1.18	34.57	1.33
7.66	1.06	23.93	1.21	36.49	1.36
11.23	1.09	26.86	1.24	38.31	1.39
14.42	1.12	29.67	1.27	40.43	1.42
17.60	1.15	32.35	1.30	41.91	1.45

(Richter.)

Sp. gr. of $CaCl_2$+Aq at 19.5° containing pts. $CaCl_2$ to 100 pts. H_2O.

Pts. $CaCl_2$	Sp. gr.	Pts. $CaCl_2$	Sp. gr.
6.97	1.0545	36.33	1.2469
12.58	1.0954	50.67	1.3234
23.33	1.1681	62.90	1.3806

(Kremers, Pogg. 99. 444.)

Sp. gr. of $CaCl_2$+Aq. G=sp. gr. at 15° if % is $CaCl_2$, according to Gerlach; S=sp. gr. at 18.3° if % is $CaCl_2+6H_2O$, according to Schiff.

%	G	S	%	G	S
1	1.00852	1.0039	36	1.35610	1.1575
2	1.01704	1.0079	37	1.36790	1.1622
3	1.02555	1.0119	38	1.37970	1.1671
4	1.03407	1.0159	39	1.39150	1.1719
5	1.04259	1.0200	40	1.40330	1.1768
6	1.05146	1.0241	41	...	1.1816
7	1.06033	1.0282	42	...	1.1865
8	1.06921	1.0323	43	...	1.1914
9	1.07808	1.0365	44	...	1.1963
10	1.08695	1.0407	45	...	1.2012
11	1.09628	1.0449	46	...	1.2062
12	1.00561	1.0491	47	...	1.2112
13	1.10494	1.0534	48	...	1.2162
14	1.12427	1.0577	49	...	1.2212
15	1.13360	1.0619	50	...	1.2262
16	1.14332	1.0663	51	...	1.2312
17	1.15305	1.0706	52	...	1.2363
18	1.16277	1.0750	53	...	1.2414
19	1.17250	1.0794	54	...	1.2465
20	1.18222	1.0838	55	...	1.2516
21	1.19251	1.0882	56	...	1.2567
22	1.20279	1.0927	57	...	1.2618
23	1.21308	1.0972	58	...	1.2669
24	1.22336	1.1017	59	...	1.2721
25	1.23365	1.1062	60	...	1.2773
26	1.24450	1.1107	61	...	1.2825
27	1.25535	1.1153	62	...	1.2877
28	1.26619	1.1199	63	...	1.2929
29	1.27704	1.1246	64	...	1.2981
30	1.28789	1.1292	65	...	1.3034
31	1.29917	1.1339	66	...	1.3087
32	1.31045	1.1386	67	...	1.3140
33	1.32174	1.1433	68	...	1.3193
34	1.33602	1.1480	69	...	1.3246
35	1.34430	1.1527	70	...	1.3300

(Calculated by Gerlach, Z. anal. **8**, 283.)

Sp. gr. of [illegible] a = no. of *half molecules* in [illegible] in 1000 g. H_2O; b=sp. gr. at 24.3° when a=$CaCl_2+6H_2O$ (½ mol.=109.5 g.); c=sp. gr. at 24.3° when a=$CaCl_2$ (½ mol.=55.5 g.).

a	b	c	a	b	c
1	1.041	1.043	7	1.198	1.258
2	1.076	1.084	8	1.214	...
3	1.106	1.122	9	1.229	...
4	1.133	1.159	10	1.242	...
5	1.157	1.193	11	1.255	...
6	1.179	1.227	..	...	...

(Favre and Valson, C. R. **79.** 968.)

Sp. gr. of $CaCl_2$+Aq at 18°.

% $CaCl_2$	Sp. gr.	% $CaCl_2$	Sp. gr.
5	1.0409	25	1.2305
10	1.0852	30	1.2841
15	1.1311	35	1.3420
20	1.1794	..	....

(Kohlrausch, W. Ann. **1879.** 1.)

$CaCl_2$+Aq sat. at 0° has sp. gr.=1.367. (Engel, Bull. Soc. 1887, (2) **47.** 318.)

Sp. gr. of $CaCl_2$+Aq at 9.5°C.

Mass of salt per unit mass of solution	Density of solution (g. per cc.)
0.00191	1.00168
0.00381	1.00317
0.00570	1.00465
0.00759	1.00615
0.00947	1.00765
0.01320	1.01050

(McGregor, C. N. 1887, **55.** 6.)

Sp. gr. of $CaCl_2$+Aq at 25°.

Concentration of $CaCl_2$+Aq.	Sp. gr.
1-normal	1.0446
1/2- "	1.0218
1/4- "	1.0105
1/8- "	1.0050

(Wagner, Z. phys. Ch. 1890, **5.** 36.)

Sp. gr. at 16°/4° of $CaCl_2$+Aq containing 12.1638% $CaCl_2$=1.10489. (Schönrock, Z. phys. Ch. 1893, **11.** 768.)

Sp. gr. of $CaCl_2$+Aq at 17.925°C.

% $CaCl_2$	Sp. gr.	% $CaCl_2$	Sp. gr.	% $CaCl_2$	Sp. gr.
0.0	0.99869	13	1.11206	33	1.31562
0.1	0.99954	14	1.12130	34	1.32689
0.2	1.00037	15	1.13067	35	1.33821
0.3	1.00116	16	1.14016	36	1.34956
0.4	1.00201	17	1.14969	37	1.36100
0.6	1.00371	18	1.15926	38	1.37242
0.8	1.00539	19	1.16920	39	1.38400
1.0	1.00703	20	1.17910	40	1.39489
1.5	1.01127	21	1.18897	41	1.40641
2	1.01548	22	1.19901	42	1.41770
3	1.02386	23	1.20901	43	1.42882
4	1.03238	24	1.21918	44	1.44007
5	1.04089	25	1.22941	45	1.45124
6	1.04951	26	1.23969	46	1.46238
7	1.05822	27	1.25030	47	1.47329
8	1.06680	28	1.26092	48	1.48450
9	1.07569	29	1.27182	49	1.49573
10	1.08467	30	1.28271	50	1.50676
11	1.09373	31	1.29360	51	1.51778
12	1.10288	32	1.30461		

(Pickering, B. 1894, **27.** 1385.)

Sp. gr. of $CaCl_2$+Aq at t°.

t°	Concentration of $CaCl_2$+Aq	Sp. gr.
20	1 pt. $CaCl_2$ in 7.1045 pts. H_2O	1.1062
20	1 " " " 164.25 " "	1.0032

(Hittorf, Z. phys. Ch. 1902, **39.** 628.)

Sp. gr. of $CaCl_2$+Aq at 20°.

g. mols. $CaCl_2$ per l.	Sp. gr.
0.010	1.000982
0.025	1.002539
0.050	1.004874
0.075	1.006814
0.10	1.008971
0.25	1.02267
0.50	1.04451
0.75	1.06641
1.00	1.08744

(Jones and Pearce, Am. Ch. J. 1907, **38.** 696.)

Sat. $CaCl_2$+Aq forms a crust at 150°, and contains 178 pts. $CaCl_2$ to 100 pts. H_2O. (Gerlach.)

Sat. $CaCl_2$+Aq boils at 180°. (Rüdorff.)

B.-pt. of $CaCl_2$+Aq containing pts. $CaCl_2$ to 100 pts. H_2O. G = according to Gerlach (Z. anal. **26.** 440); L = according to Legrand (A. ch. (2) **39.** 43).

B.-pt	G	L	B.-pt.	G	L
101°	6.0	10	134°	...	117.2
102	11.5	16.5	135	119	...
103	16.5	21.6	136	...	123.5
104	21.0	25.8	138	...	129.9
105	25.0	29.4	140	137.5	136.3
106	29.0	32.6	142	...	142.8
107	32.5	35.6	144	...	149.4
108	35.5	38.5	145	157	...
109	38.5	41.3	146	...	156.2
110	41.5	44.0	148	...	163.2
111	....	46.8	150	178	170.5
112	....	49.7	152	...	178.1
113	....	52.6	154	...	186.0
114	....	55.6	155	200	...
115	55.0	58.6	156	...	194.3
116	....	61.6	158	...	203.0
117	....	64.6	160	222	212.1
118	....	67.6	162	...	221.6
119	....	70.6	164	...	231.5
120	69.0	73.6	165	245	...
121	....	76.7	166	...	241.9
122	....	79.8	168	...	252.8
123	....	82.9	170	268	264.2
124	....	86.0	172	...	276.1
125	....	89.1	174	...	285.5
126	....	92.2	175	292	...
128	....	98.4	176	...	301.4
130	101	104.6	178	305	314.8
130.4	102.67	...	179.5	...	325.0
132	....	110.9	...	...	...

B.-pt. of $CaCl_2$+Aq.

% $CaCl_2$	B.-pt.	% $CaCl_2$	B.-pt.
5.6	101°	17.5	104°
10.3	102	20.0	105
14.5	103	....	...

(Skinner, Chem. Soc. **61.** 340.)

Less sol. in HCl+Aq than in H_2O. HCl+Aq sat. at 12° dissolves 27% $CaCl_2$, which crystallizes out with $2H_2O$. (Ditte, C. R. **92.** 242.)

Solubility of $CaCl_2$ in HCl+Aq at 0°.

Sp. gr. of solutions	g. per 100 cc. solution	
	$CaCl_2$	HCl
1.367	51.45	0.0
1.344	46.45	3.32
1.326	42.80	5.83
1.310	36.77	10.66
1.283	29.84	15.84
1.250	20.12	23.05
1.238	11.29	34.62

(Engel, C. R. 1887, **104,** 434.)